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The Baltimore & Ohio expects to begin operating its new tunnel terminal in Baltimore by Jan. 1. The three 95-ton electrical locomotives which are to handle trains in the tunnel are approaching completion. These locomotives have four pairs of drivers and an electric motor on each axle.

A conduit system of electric traction is to be installed on Lexington Ave., New York city, and the work of construction has begun. The system will be put in by the General Electric Co. under a contract with the Metropolitan Traction Co.

A down-town loop is to be built by the Alley L. or Chicago & Southside Rapid Transit Co., for its elevated line on the south side of the river in Chicago, according to the newspaper reports. It is stated that the new line will run from the present northern terminus of the line near Harrison St., north through an alley to Adams St., then west to Clark St., south to Harrison St., and east along Harrison St. to the starting point. The right of way is said to have been practically all secured and the announcement is also made that the line will be completed within the next six months.

A masonry dam with movable wickets is to be built at the lower end of the Chicago Drainage Canal at Lockport, Ill. The contractors on Section 15 are to turn over 1,000 ft. of completed canal at the lower end by next spring, and on this section the controlling works will be located. Mr. Isham Randolph, Chief Engineer of the Drainage Canal, has recently inspected the various types of movable dams on the Ohio, Mississippi and St. Croix rivers and favors the Lang bear trap, in use at the Nevers' dam on the St. Croix, as the best type for the works at Lockport.

A four-mile intake tunnel is proposed for the water-works of Cleveland, and a new pumping station on the East Side. It is stated that the tunnel will be 9 ft. in diameter, and that the intake will be in 50 ft. of water. The present intake tunnel extends over a mile beneath Lake Erie.

The latest water-power tunnel project talked of is one to take the waters of Lake Erie to Hamilton, Ont. The distance across, from Lake Erie to Lake Ontario, at this point, is about 32 miles, and the difference in the level of the lakes is about 333 ft. The supply of unlimited water and electric power to Toronto and other towns on the lower lake are the objects in view. While there is no harm done by investigating the feasibility and cost of such a project, it would seem that the good people of that section were evolving power schemes sufficient to drain the lakes, as well as the pockets of too-confiding investors.

The leak in one of the basins of the new Roxborough reservoir of the Philadelphia water-works has been discovered after nearly a year, it is said, of search. Recently a depression was discovered in one of the embankments about 3 ft. from the bottom. On removing the brick lining it was found that the clay beneath it had been washed away over a small area, and that below there was a fissure in the rock from 6 to 10 ins. in width. Through this fissure and an underground passage the water escaped, coming to the surface on a hillside 1,200 ft. away, if reports be true. Work on this basin was begun Jan. 13, 1891, and water was first pumped in on Sept 21, 1893. When the reservoir had been filled to a depth of 20 ft. an increased flow was detected in a near-by spring and the water finally fed to 4 ft. It is stated that from that time until a few days ago unsuccessful search has been made for the leak.

A water supply intake 900 ft. long and 20 ins. in diameter is being constructed for the Queen City Cotton Mills, at Burlington, Vt., by Mr. Joseph G. Falcon, who constructed the intake for the water-works of that city, described in our issue of June 21, 1894. The intake pipe will be of cast iron, weighing 190 lbs. per ft., and will have 28 Falcon flexible joints (Eng. News, June 8, 1893). The pipe will be laid in a trench 4 ft. deep dredged in the sandy bottom of Lake Champlain, and at its intake end will be provided with a cylindrical strainer 3 ft. in diameter and 7 ft. long, perforated with 14,000 ⅜-in. holes. This cylinder will be of boiler iron ⅜ in. thick and will be supported on a timber crib work.

An additional water supply for Manchester, England, has just been introduced from Thirlmere Lake, 96 miles from the city service reservoir, with Mr. G. W. Hill, of Manchester as designing and constructing engineer. The full project contemplates raising the surface of the lake 50 ft. by means of a 56-ft. concrete dam and the construction of aqueducts with a total daily capacity of about 60,000,000 gallons; but thus far the water level has been raised only 20 ft. and an aqueduct capacity of but 12,000,000 gallons has been provided. The storage capacity of the lake when the dam is completed will be about 9,750,000,000 gallons and the water area will be 793 acres, the original area having been 328 acres. The annual rainfall at the lake varies from 80 to 90 ins., the heaviest recorded in the kingdom being at Seathwaite, near by. The aqueduct, where feasible, is a concrete tube 7 ft. in diameter, but where there is internal pressure, it consists, or will when completed, of five lines of cast iron pipe, only one of which has thus far been laid. Of the total length of 96 miles, 36 are of concrete, 14½ are in tunnel, and 45 miles are of iron pipe. The longest tunnel is at the head of the aqueduct and is 8½ miles in length. An inverted siphon 9½ miles long crosses the valley of the River Ribble. A siphon beneath the Lune is under 480 ft. head at its lowest point. The total estimated cost of the work is about $17,000,000, and the parts thus far completed have cost about $12,000,000, being slightly under the estimate. The work was authorized in 1879, but the necessary land was not secured and preparations made for the work until 1886.

The most serious railway accident of the week was a rear collision Oct. 31 on the Delaware, Lackawanna & Western R. R. at Foster, Pa. A coal engine was backing down the southbound track, and, owing to a crossover switch having been left open, it was turned onto the northbound track, right in front of a northbound express train. The coal engine was upset and the express engine thrown upon it. One engineman and both firemen were killed.—A rear collision occurred Nov. 1 on the Baltimore & Ohio R. R., at Rankin, Pa., in which one man was killed and another fatally injured. An express train had stopped, but the rear flagman did not go back far enough to protect it, and the train was run into by an accommodation train.

The large freight house of the Bridge & Terminal Ry. at East St. Louis, Ill., was burned Oct. 28, and about 200 loaded and empty freight cars were destroyed, involving a loss of about $500,000. The building was 750 ft. long.

A new bridge at Ogontz, Pa., built to carry the Philadelphia, Cheltenham & Willow Grove Electric Ry. over Tacony Creek, collapsed Oct. 31.

The bursting of a 3-in. tube in one of the boilers of the Edison Electric Light Co.'s plant at Cincinnati, O., on Nov. 2, resulted in fatal injuries to two men and serious injuries to a third, the men being terribly scalded by escaping steam and hot water.

One of the reservoirs which supply water to Ansonia, Conn., broke on Nov. 3, washing out about 200 ft. of the roadbed of the New York, New Haven & Hartford R. R.

Nicaragua Canal promoters claim that word has been received here that money for its construction has been secured from foreign capitalists. Last summer Messrs. Smith M. Weed and John R. Bartlett, as a committee of the Nicaragua Canal Construction Company, went abroad for this purpose. A bill has also been introduced into the Vermont State Senate to incorporate the Nicaragua Company, for the purpose of building a canal through Nicaragua and Costa Rica, to succeed the Nicaragua Canal Construction Company, which has been in process of reorganization for some time.

The movement to construct public docks in Boston harbor is assuming a more definite shape. The Board of Aldermen recommend them and the Mayor is requested to petition for legislative action. According to the plans formulated, which are almost too broad and elaborate, the site selected is a portion of marsh and flats in East Boston, nearly a mile square. Eight piers, six slips and two dry-docks are proposed with an impressive array of sheds, store houses, grain elevators, railways, etc. Under the plan this would all be public property, leased with a view to vastly increasing the commercial facilities of the port. The estimated cost is not given.

The steamer "St. Louis," of the American Line, built by the Cramps, of Philadelphia, and to be launched this month, has the following general dimensions: Length over all, 554 ft. 2 ins.; length between perpendiculars, 535 ft. 8 ins; extreme breadth, 63 ft.; molded breadth, 62 ft. 9 ins.; molded depth, 42 ft.; depth from top of keel to top of first deck, 51 ft.; designed load draft, 26 ft.; number of decks, five, from 7 ft. 2 ins. to 9 ft. high each; 24 water-tight compartments; gross tonnage, 10,770 tons; displacement at 26 ft. draft, about 16,000 tons of salt water; cargo capacity on same draft, 1,820 tons; but loaded to 28 ft., cargo capacity is 3,200 tons. The motive power consists of two quadruple expansion, vertical, six-cylinder engines on four cranks, driving twin-screws, and using steam at 200 lbs. pressure. The estimated aggregate horse-power is 20,000. The first frames for the "St. Louis," and a sister ship, the "St. Paul," were laid on July 27, 1893, and in about 15½ months the first ship will be launched. Every item entering into their construction is of domestic material and manufacture, and they will be fitted throughout with every convenience and labor-saving device. Each of these ships can carry 320 first cabin and 220 second cabin passengers, 900 steerage and 400 in the crew, including stewards, or 1,840 persons in all. Economy in coal consumption is to be one of the features of these American ships.

The new Tower bridge across the Thames in London which was opened three months ago, has now a daily average traffic of 70,000 foot passengers and over 8,000 teams. It has reduced the crowd on London Bridge by nearly one-half.

The weight of English trains is commented upon by a correspondent of the "Engineer," of London, in referring to a recent collision. He gives a total train-load of 356 tons, including two engines, or 162 tons for two engines and tenders hauling 194 tons of cars. He states that the figures given seem to show either that the six-wheeled rolling stock still used by the East Coast lines run with more friction than the bogie cars on the Great Western and Midland railways, or that the ponderous compound locomotives recently built by the Northeastern Railway cannot haul a train of only 14 cars over easy grades without a pilot engine. The approximate weight of train was as follows:

	Tons.	
1st engine	40	
Tender	50	
2d engine	50	
Tender	42	
Total, engines and tenders	—	162
13 6-wheelers	169	
1 Pullman	25	
Total, cars	—	194
Total weight		356

He thinks there is no doubt whatever that an engine (type not stated, but presumably with four coupled wheels, and probably of the eight-wheel type), weighing 39 tons, and tender, with water scoop, weighing 15 tons, altogether weighing 54 tons—equal to only 28% of car weight instead of 84%, as above—would easily have hauled the train in question. Some figures of actual loads of American express trains and their engines were given in our issues of Jan. 12 and April 13, 1893.

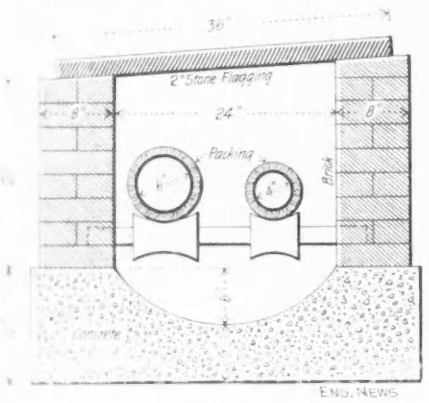
The Lake Washington canal is to be commenced on March 1, 1895, and is to be completed in six years under a contract signed by the Governor of Washington on Oct. 27. The work is to be done by the Seattle & Lake Washington Canal Co., of which ex-Governor Ferry is president. This canal will connect the head of Elliott Bay with Lake Washington and provide a waterway sufficient to carry vessels 300 ft. long, 75 ft. beam and 22 ft. draft.

A MASONRY CONDUIT FOR STEAM PIPES.

By J. L. Bauer.

Heretofore conduits for steam pipes have been quite generally constructed of the ordinary hub and spigot earthenware sewer pipe. The advantage of the use of this earthenware pipe is its small cost, while the main disadvantage is that it is quite impossible to get at the steam pipes for inspection and repairs without destroying the conduit. With the use of the conduit here described, and shown in section in the accompanying cut, the steam pipes and appurtenances may be easily reached by the removal of the flagging cover of the conduit.

The conduit has a concrete foundation and invert, laid on a slightly descending grade, and with the invert troweled to a smooth surface. Brick walls



Section of Masonry Couduit for Steam Pipes in Grounds of the University of the City of New York; Chas. B Brush, Engineer.

8 ins. thick are laid upon this foundation, and the whole is covered with 2-in. stone flagging, excepting underneath drives, where 4-in. flagging is used. The wall on one side is carried up one course higher than the wall on the other side, so as to give a slight pitch to the cover-stone, for the purpose of shedding water. The joints of the flagging are cemented and it is laid in cement mortar.

A steam pipe conduit of the section shown in the cut is now being constructed for the University of the City of New York, at University Heights, New York City. Mr. Charles B. Brush, M. Am. Soc. C. E., is the engineer in charge.

The cost of this conduit complete, including excavation, and laid so as to secure about 2 ft. covering of earth, is $1.95 per lin. ft.

It may be of some interest to note here that an alternate bid was received for a conduit of 24-in. stoneware split pipe, the bid being $1.90 per lin. ft., only 5 cts. less than the cost of the conduit now being constructed.

THE REPORT OF THE BUREAU OF STEAM ENGINEERING.

In his annual report as Chief of the Bureau of Steam Engineering, just issued, Engineer-in-Chief Geo. W. Melville reviews the work done and inaugurated during the fiscal year ending June 30, 1894. At the New York Navy Yard work is commenced upon the new machinery for the protected cruiser "Chicago," for which a special appropriation was made. This first ship of the "new navy" was built by John Roach & Sons, of Chester, Pa., under a contract signed in July, 1883, and was fitted with engines of 5,084 I. HP., calculated to give her a speed of 15.3 knots per hour. The old twin-screw compound overhead beam engines are now to be replaced by slightly inclined triple expansion engines of 9,000 I. H.P. In planning the new machinery the Bureau aimed to design it so that it could be placed in the vessel without cutting or removing the protective deck or any of the principal framing. The smaller space occupied by the new engines will increase the coal capacity by 100 tons, increase the speed 3 knots per hour and enlarge the radius of action about 22%.

Preliminary plans have been prepared for the machinery for two torpedo-boat destroyers; one to have 6,000 I. HP. and the other 4,500 I. HP. Specifications and plans are being made for the machinery of three torpedo boats, with vertical, twin screw, triple expansion, four-cylinder engines of 2,000 I. HP. These engines are to be balanced by placing the cranks opposite and at right angles, and by making all the moving parts of each engine of the same weight. Each engine will be placed, with its auxiliaries, in a separate water-tight compartment, one forward of the other. There will also be two boilers, one forward and the other aft, in separate compartments; the purpose being in both cases to minimize the chance of disabling the entire machinery by a single shot. The machinery for the two third-class torpedo boats for the armored cruiser "Maine" is built and ready for erection in the boats; and the machinery for two similar boats for the "Texas" is now being built.

In designing this machinery the Bureau has, despite much adverse criticism, always insisted upon a fair proportion of weight for power, especially in the boilers. Commodore Melville says that this course is justified by the fact that there have been no failures on trial trips, and, without exception, all machinery built upon the Bureau designs has done all, and more than all, required of it on the first trial, without distress, accident or injury of any kind. This is a unique record, and one to be justly proud of when the high power and unprecedented speed of some of these vessels are considered. The Bureau considers that much of this success is due to its uniform practice of allowing ample power for the speed required with a given displacement, as determined from the carefully observed performances of similar vessels. Every design, also, before its final adoption, is carefully scrutinized by an engineer officer who has performed service at sea; this being considered by the Bureau as the only way in which it could obtain much information absolutely essential to the successful design.

After dealing with the navy yards separately, and pointing out the new tools and buildings required at each, the report gives in detail the present condition of the machinery of naval vessels. The contract trials of the new ships "Marblehead," "Montgomery," "Olympia," "Columbia" and "Minneapolis," all completed in the fiscal year, are fully described, and the unprecedented speed of the "Minneapolis" and "Columbia" is made a subject of special comment. The detailed results of the trials of these vessels are given in tabular form.

THE PARIS SEWERS AND SEWAGE FARM.

By Prof. William P. Mason.

The sewers of Paris, aggregating over 750 miles in length, constitute one of the sights of the city. They may be inspected without charge on the first and third Wednesdays of each month in summer by writing for a permit to the Prefect de la Seine. Descent is commonly made near the Madeleine by a substantial stairway of stone, and the boats awaiting the party at the foot of the steps are fully as large and quite as comfortable as Venetian gondolas.

The great sewer, which is tunnel-like in dimensions, being 16 ft. high and 18 ft. broad, is, on occasion of a visit, lighted with lamps alternately red and blue, and as these stretch away into the distance the effect is decidedly striking. In section the sewer has the shape shown in the accompanying cut.

Under ordinary circumstances the sewage confines itself to the central channelway, but upon occasion rises above the sidewalks on either hand. The central channel I should estimate as 10 ft. wide and 4 ft. deep, with a flat curved bottom and a walk on either side. The boats, with their loads of visitors, are pulled by ropes in the hands of attendants, who walk along the sidewalks. On either side of the sewer may be seen the large mains carrying the city water supply and also the telegraph cables.

The "collecteur general," or main collecting sewer, after receiving the contents of the tributaries, starts from the Place de la Concorde and descends to Asnieres, nearly 3½ miles distant.

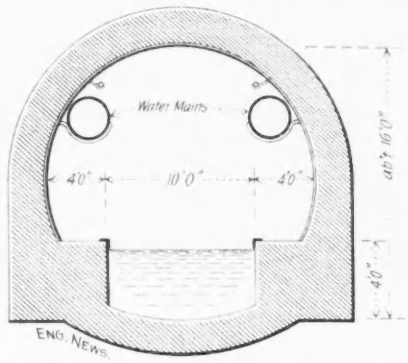
This great sewer carries about 350,000 cu. ft. of sewage per hour (63,000,000 gallons per day), but is capable of passing many times that quantity.

The sewage from that portion of the city lying on the left bank of the Seine is piped under the river, passes below the Avenue Marceau and the Place de l'Etoile at a depth of about 100 ft. from the surface of the ground, and joins the "collecteur general" not far from the point where the latter empties its contents into the Seine.

Before the mouth of the main sewer is reached, a portion of its contents is deflected and used for irrigation upon the farm and "model garden" at Asnieres.

Sewage for the purpose of this irrigation is conducted throughout the irrigated district in open conduits of earth about 2 ft. wide and 3 ft. above the surface of the surrounding country. Small side gates at intervals admit the sewage to the furrows between the rows of growing plants; such gates being opened and the furrows filled whenever, in the judgment of the attendant, the vegetation can appropriate the sewage.

The face of the land is all divided into small sections, in places less than an acre in area, and each such division is flooded independently. What is very important to note is that the filtration of the



Cross-Section of the "Collecteur General," Paris.

sewage through the soil is entirely intermittent in character, and that nitrification is given abundant opportunity for full development.

Any surface-clogging of the ground is avoided by suitable use of the spade. So far as the quantity and quality of the crops raised are concerned, they appear to be very near perfection.

Flowing at the base of the gentle slope of the irrigation district is a sparkling stream, several feet wide, consisting of the effluent or underdrainage of the sewage farm. It is full of trout and has the appearance and taste of ordinary drinking water. The distance of this stream from the nearest irrigation point is about 100 ft. The average analysis for the year 1889 of the sewage admitted to the farm and of the water of the effluent stream mentioned above was as follows:

(Parts per 100,000.)

	Sewage.	Stream.
Chlorine	7.80	7.10
Organic matter	4.50	0.14
Nitrogen as nitrates	0.68	2.31

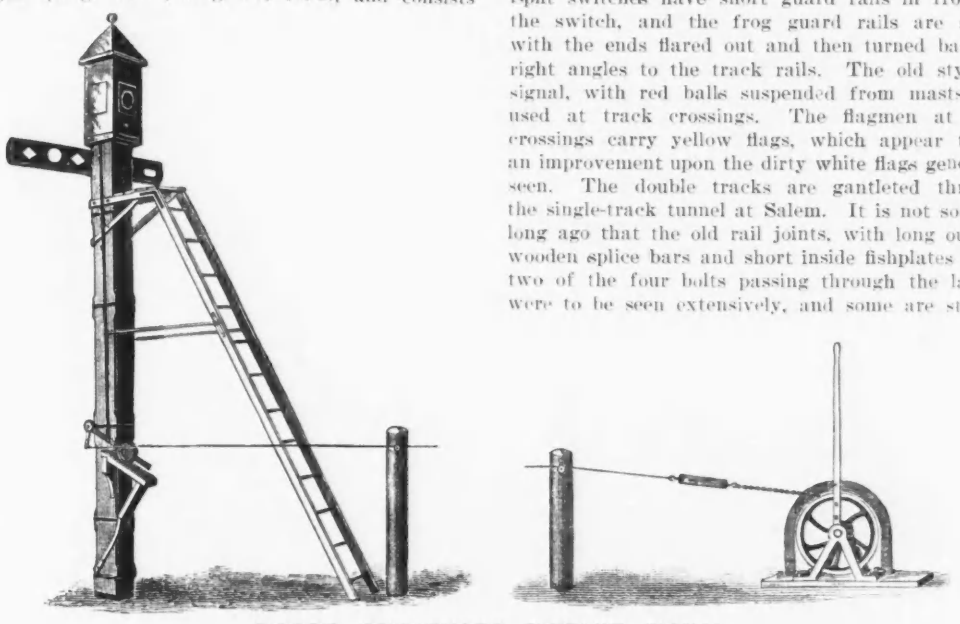
A bill has recently been introduced in the Chamber of Deputies asking for an appropriation of 117,000,000 fr. ($22,200,000) to permit of the purification of the entire volume of the Paris sewage upon the irrigation plan.

NOTES BY RAIL.

Canadian Pacific Ry.—The line from Montreal to Toronto, 348 miles, is mostly single track, laid with 72-lb. Sandberg rails. The joints are square and are carried by three ties, spliced by 40-in. angle bars and six bolts (Eng. News, Jan. 19, 1893). There are 16 ties to a rail length with this track, and 15 ties where four-bolt angle-bar suspended joints are used. Loose spikes and bad ties are not infrequent, and in one place the rails rested on some old worn shins, which had apparently been overlooked by the sectionmen. The new ties which are being put in are exceptionally wide, sawed on both faces and with the bark left on the sides. Some, however, are sawed on all four sides. The ballast is a dusty gravel. Iron surface cattleguards are used to some extent, but in general they are of the pit type, walled up with timber and crossed by stringers. Bridges have two outside guard timbers on each side. The outer one is near the ends of the ties, and the inner one is a flat timber laid close to the rail and faced with an angle iron. The latter timber extends the whole length of the bridge floor and curves out sharply on the abutments to meet the extended end of the outer guard. The curve or flare is so sharp that derailed wheels would be more likely to jump over than to be guided by the guard. The stub switch is used in yards and sidetracks and a "safety" stub switch on the main track, which is a half-Cooke switch so arranged as

to prevent derailment from the main track. The switchstands have each a single oval red target of wood, though double targets are recognized as being the best arrangement. The Piper semaphore train order signal is used, and stations are protected each way by the Piper semaphore distant signal, operated by return wires by means of levers and a winding drum at each end of the station platform. The distant signal has the blade pivoted at the middle and the lamp is mounted in a case on top of the post. Inside this case is another case, sliding vertically and having two holes in the side, one fitted with red and the other with a green or white lens. This sliding case moves in conjunction with the semaphore arm, which arm has a hole through which the light shows when the arm stands vertical, indicating "track clear." The signals are made by Noah L. Piper & Son, of Toronto, are used both on Canadian and American roads. The latest form, with a single wire, is shown in the cut.

The regular day train is hauled by a ten-wheel engine (Eng. News, Aug. 30, 1890), and consists



PIPER'S SEMAPHORE DISTANT SIGNAL.

of a baggage and express car, a second-class car, a first-class car, a through sleeping car for Chicago (Eng. News, Nov. 10, 1888) and a dining car. On the occasion of our trip the vestibules of the sleeping and dining cars were of such different makes that they could not be coupled together. The first-class cars are handsomely finished in white mahogany and have Forney seats; but the seats are so low as to be uncomfortable. There are five double-light roof lamps, but the light was miserable. In the sleeping cars, however, the light was much better. The journal oil boxes are filled profusely and wastefully, and the economy of a good oil box which will not leak is evident when we see the ballast black with oil and the ends of the ties thickly crusted with dirt and oil. The greasy condition of the tracks in the Windsor St. Station at Montreal was referred to in the article on Canadian railways in our issue of Jan. 19, 1893. This is now partly concealed by a filling of loose sand between the rails, which is smoothed over occasionally by a scraper, but where the planking is laid close up to the rails the planks are slimy and black with grease. At Toronto the Union Station is being enlarged, a new trainshed having been built parallel with the old one, the station building separating the two trainsheds. A handsome new station building is to be erected, which we shall illustrate shortly. The architects are Symons & Strickland, of Toronto.

Boston & Maine R. R.—The new Union Station at Boston is a large and handsome structure, well arranged and fitted up. The trainshed covers 23 tracks, six of which are under the old Boston & Maine trainshed adjoining, which forms a part of the new station. The new trainshed has triangular roof trusses, supported on columns placed on the center line of the platforms, there being two tracks between each pair of platforms. The Ellis bumping post (Eng. News, Oct. 6, 1892) is used at the ends of the tracks. The staff includes some porters, attired in velveteen, in a rather clumsy imitation of the English railway porters, but, as at most American stations, there are not enough of these men, and they are inferior in many ways to the English porter. The new rails weigh 75 lbs. per yd. and are laid with suspended joints, spliced by heavy angle bars, with six button-head bolts closely spaced. The older six-bolt joints were supported, and had long angle bars with bolts spaced very far apart. The inside bars were rolled with ribs to engage the rectangular heads of the bolts. Four-bolt angle-bar supported joints are also extensively used, some old styles having very widely spaced bolts. The double Excelsior nut-locks are used. The ordinary track has 19 to 20 ties to a rail length, the ties being generally quite narrow, and the track is only in fair condition, there being many spikes loose and forced out of the spike slots in angle bars; ties badly cut and not properly spaced. The Rockport branch is double track as far as Manchester, and laid with the heavy track. Split switches have short guard rails in front of the switch, and the frog guard rails are short, with the ends flared out and then turned back at right angles to the track rails. The old style of signal, with red balls suspended from masts, are used at track crossings. The flagmen at road crossings carry yellow flags, which appear to be an improvement upon the dirty white flags generally seen. The double tracks are gantleted through the single-track tunnel at Salem. It is not so very long ago that the old rail joints, with long outside wooden splice bars and short inside fishplates (only two of the four bolts passing through the latter) were to be seen extensively, and some are still to be seen on the Western Division. This road has a number of ordinary day cars with the arched, or "turtleback," roof, and is changing the color of its cars from yellow to a dark sepia or Pullman brown.

Maine Central R. R.—Clean sand ballast is extensively used, and a good deal of the track is being raised with an extra supply of ballast. The sand, however, must be very hard on the motion and journals, as the trains run in a cloud of fine, gritty dust. Perhaps the value of ballast free from dust, in regard to the popularity of a railway, is not generally recognized, but where the passenger traffic is important it is as good policy to ensure freedom from dust by using a clean ballast as it is to ensure freedom from smoke and cinders by using hard coal. The ballast is level with the tops of the ties, and in some places is shouldered out beyond the ends, while in others it is sloped down from the end. Unbarked ties are used, which look very ragged in the track, but sawed ties are used at culverts and pit cattleguards. There are about 17 ties to a rail length on branches and 19 on main track. The rails are laid with square supported joints, spliced by four-bolt angle bars (or, in some places, fishplates). The split switches have automatic switchstands instead of a spring on the switch rod. Rigid plate frogs are used, and iron foot-guards are used at all guard rails, heels of frogs, etc. The foot-guard consists of an iron plate about 3 ins. wide, set on edge, and bent in a loop to fit between the rail webs, the ends of the plate being bolted to the webs. The switchstands have single targets only.

Many road crossings have no cattleguards, but only whitewashed wing fences, while pit cattleguards are used in other cases. Several masonry culverts are being built. The mile posts are stone slabs about 15 ins. wide and 5 ft. above the ground, having the top painted white and the distance to divisional points (Bangor and Portland on the main line and Lunenburg and Portland on the White Mountain line) painted in red on both sides. Yard limit signs are boards 3 × 14 ins., painted red, with white top and "Yard Limit" in black letters. Clearance posts are short white stakes with pyramidal iron caps. The whistle signs are of sheet iron, oval or diamond-shaped, fastened to the tops of square posts. They are painted white, with "Whistle Here" in red letters, instead of the usual "W." Where track work is in progress a board "Slow" sign is put up instead of a flag. Bridge tell-tales have a horizontal pivoted rod, which swings upward and to one side when struck. Wooden and iron bridges are painted a yellow ochre. There is a good deal of the McMullen woven wire fencing, fastened to top rails of poles, and four barbed wires and a top pole are also used. On rocky and swampy ground the posts are let into sills, made of half-lengths of old ties, with braces back and front. At stations there are distant semaphore signals, with arms pivoted at the middle, the signals being operated by drums and levers on the station platform, similar to those on the Canadian Pacific Ry., described above.

New York, New Haven & Hartford R. R.—This road is using very extensively on its main tracks the 100-lb. rails, whose section was shown in our issue of May 4, 1893. They are laid with broken suspended joints, spliced by short angle bars and four button-head bolts. The bolts have the heads outside and square nuts and double Excelsior nut-locks on the inside. The ties are used liberally, being spaced very closely. The change in riding of the cars when the train passes from the older and lighter rails onto these heavy rails is very marked. On the lighter track the old form of outer splice bar, with a rib along the side of the rail head, is still extensively used. Considerable work is in progress on the four-track work and improvement of grades on the New York Division, and large quantities of good stone ballast are being put down on the new tracks (with 100-lb. rails) and to replace gravel ballast on the older tracks. Immense sums of money have been expended in eliminating grade crossings on this division, and at Bridgeport work is now in progress for raising the track grade and lowering the street grade at Fairfield Ave. so as to avoid a grade crossing of a new electric railway. This road runs a fast express train (made up of parlor cars) each way between New York and Boston, which makes the trip of 234 miles in five hours, with but three stops. On this an extra fare is charged, which is entirely out of proportion to any advantage gained by the comfort or speed of the train. From New Haven to New York the extra charge is $2, or $3.50 in all, and the time is 90 minutes for the 74 miles. A train with day and parlor cars leaving five minutes later gets into New York only 25 minutes later. The parlor cars of the fast express are certainly very handsome, but do not ride easily, having a constant succession of lateral shocks, as though the center plates did not fit. In fact, they do not ride as easily as the day cars, which, on this road, are especially comfortable. These parlor cars also have too many curtains and drapery, which, though of silk, and consequently lighter than the old, and happily almost obsolete, plush curtains, yet suffice to hold a very unpleasant and unhealthy amount of dust. A noticeable feature of many of the new locomotives on the road is the height at which the boiler is placed and the consequent use of a very stumpy-looking smokestack.

Phillips & Rangeley R. R.—This is a line of 24 ins. gage, 29 miles long, forming an extension of the Sandy River R. R. from Phillips, Me., making a continuous line of 47 miles, from which the Franklin & Megantic and Kingfield & Dead River railways form a continuous branch 24 miles long. With the Bridgeton & Saco River Ry., 16 miles, and the Monson Ry, 6 miles, in other parts of the state, Maine has 93 miles of railway of 24 ins. gage, while the Wiscasset & Quebec Ry., now under construction will raise this total to 147 miles. The Phillips & Rangeley Ry. has some sharp curves and heavy grades, but no especially heavy work is encountered. The track is laid with 35-lb. steel rails, 30 ft. long, with square supported joints spliced by 17-in. inside fishplates and outside angle bars, with four bolts spaced 4, 4½ and 4 ins. c. to c. The bolts have button heads inside the rails and

hexagon nuts and spring washers on the outside. The rails are about 3¼ ins. wide and high. The ties are 4 to 9 ins. wide, 5 ins. thick and from 4 ft. 4 ins. to 5 ft. long, there being 14 to 16 ties to a rail length. Split switches are used on main track and stub switches in the yards, with "pull-over" switchstands, having a target on top of the vertical lever. The open culverts have sides of flatted logs resting on logs across the waterway, and the rails are spiked to stringers of similar flatted logs, or to plank ties 2 × 6 ins., resting on the stringers. At Rangeley there are an engine shed (accessible only by a turn-table) and a car shed. The cars are miniature copies of standard gage cars, but the passenger cars have seats for only one passenger on each side of the aisle, and seat 28 persons. They have four-wheel trucks, Miller couplers and the Eames vacuum brake. The ordinary passenger train consists of a combination mail and baggage car, smoking car, and day car, hauled by a Forney type tank engine, built by the Portland Co. in 1890. For freight trains there is a mogul engine (with frames outside the wheels) with eight-wheel tender, built by the Baldwin Locomotive Works. The fuel is coal, wood having been abandoned on account of the number of fires caused by sparks, but wood-burning engines are still used on the Franklin & Megantic Ry.

THE PROPOSED DRAINAGE SYSTEM FOR NEW ORLEANS.

The city of New Orleans, as is generally known, depends upon drainage canals and pumps to keep itself above water. These often prove entirely inadequate, so that large portions of the city are flooded to a greater or less extent. Numerous plans for supplementing and improving the present system, or lack of system, have been presented from time to time, and several months ago an advisory board was appointed to present to the city council a comprehensive plan for adoption. On Oct. 20 the advisory board submitted to the council a report of its engineering committee, which had been adopted by the full board, outlining a drainage scheme for the entire city. This committee consists of Messrs. B. M. Harrod and Henry B. Richardson, of New Orleans, and Rudolph Hering, of New York city, all members of the American Society of Civil Engineers. The substance of their report is as follows:

The character of the drainage and surface water flowing from the city will at times become more or less dirty and polluted, even after all of the sewage has been kept out by the system of sewerage now being constructed. We have, therefore, decided that the water should not be discharged into Lake Pontchartrain, which offers the nearest outfall for it, and to which it is now carried. The lake shore is a popular resort for pleasure and bathing, and to pollute the naturally clear water with the city drainage is now and would be in the future objectionable.

The proper place to discharge the daily drainage water, in our opinion, is Lake Borgne, which lies to the east of the city. The shores of this lake are not used for settlement, and no reasonable objection can be raised on any other ground to utilizing it for the above purpose. Bayou Bienvenu extends from the lake several miles toward the city, and to a point where it is practicable to discharge into it near the intersection of the lower protection levee with Florida Ave.

We have proposed four relief canals, by which excessive amounts at the time of heavy rainfalls can be removed from the city on shorter lines and directly to Lake Pontchartrain.

The main drainage canal will be nearly nine miles in length and for a part of its course will extend through the lowest, and therefore, at present, least valuable parts of the city, and will cause the entire neighborhood to be converted from a swampy into a dry territory.

When crossing the two navigation canals it is proposed to conduct the water from the main drainage canal through proper conduits laid under the former, thereby not interfering in any way with their use for navigation.

Five low-lift pumping stations are necessary on the line of the main canal, not only to cause the ordinary drainage water to flow through the main canal to the outfall, but also to lift water, when necessary, into the relief canals leading to Lake Pontchartrain. There are four of such relief canals, one from each of the upper four pumping stations, none being required from the fifth or last station.

The first, or new, canal pumping station is located at Broad St. and the New Orleans navigation canal. The lift of the ordinary drainage water is about 2 ft., that of the storm water into the main canal about 3 ft., and that of the storm water into the relief canal about 4 ft. The great length of the Metairie relief canal, as the first one is called, about 30,000 ft., makes it necessary to add about midway another pumping station near the Metairie Ridge, which we have called the Metairie pumping station. The lift required here during the highest lake level is about 15 ft., and at ordinary stages about 11 ft.

The second, or Carondelet pumping station, is located at Broad St. and the Carondelet navigation canal. The lift of the ordinary drainage water is about 2½ ft.; that of the storm water into the main canal about 3 ft., and that of the storm water into the Taylor relief canal likewise about 3 ft.

Also here the length of the relief canal requires an intermediate pumping station, called the Taylor pumping station. The lift required during the highest lake stages is about 14 ft., and at ordinary stages about 10 ft.

The third, or St. Bernard pumping station, is located on Broad St. at St. Bernard Ave. The lift here will always be about 2½ ft. on the main canal, and into the relief canal will vary from about 10 to 14 ft., according to the stages of the lake. In this, the St. Bernard, relief canal no intermediate pumping station is required.

The fourth, or Lafayette pumping station, is located on Florida Walk, at Lafayette Ave. The lift of the ordinary flow is about 3 ft.; that of the storm water into the main canal about 3½ ft., and into the Lafayette relief canal from about 11 to 14 ft.

The fifth or last pumping station, situated along the main canal, which we have called the Jourdan station, is located on Florida Ave., near the Little Sisters' Canal. The lift of the ordinary flow varies from about 16 to 19 ft., depending upon the stages of the water in Lake Borgne, and the lift of the storm water will vary from about 5 to 9 ft., likewise depending upon the water level of the lake. No relief canal is required from this station, as the shortest distance for discharging excessive quantities of water is through the main canal itself.

The branch canals and drains should be located so as to utilize as much as possible all existing canals, which, in some instances, will require enlargement, or may be reduced in size.

The size of the main canal has been fixed after considering the largest quantities of water to be dealt with and the largest practicable canal on the route selected. It has been made 70 ft. wide at the top throughout almost its entire course; that is, between the first and fifth pumping stations; or, in other words, between the first and last storm relief canals, which come into use when the main canal is no longer capable of carrying all the water from heavy rainfalls. This size is sufficient to receive and convey to Lake Borgne all water that might be objectionable if discharged into Lake Pontchartrain. The relief canals are called into use only after this limit has been exceeded, but the Metairie and Taylor relief canals receive water lifted by their respective pumping stations from some adjacent territory, this water being sent to either lake as its condition may demand.

An essential part of the proposed plan is to construct the drains and principal canals in such a manner that they will be permanent, and that their full capacity will

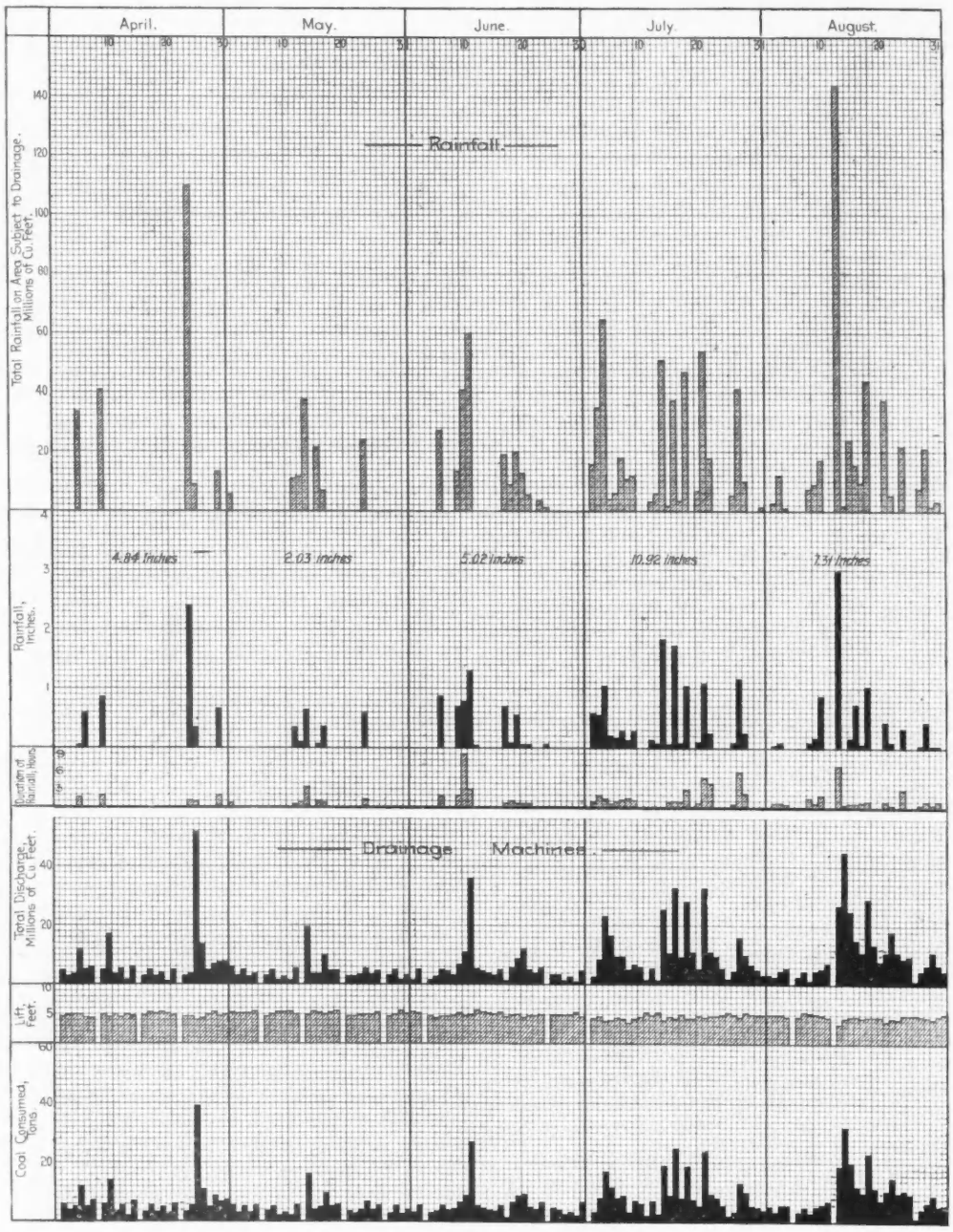


DIAGRAM SHOWING RAINFALL AND RUN-OFF AT NEW ORLEANS, APRIL TO AUGUST, 1894, INCLUSIVE, AND AMOUNT OF WATER PUMPED AND COAL CONSUMED AT DRAINAGE PUMPING STATIONS.

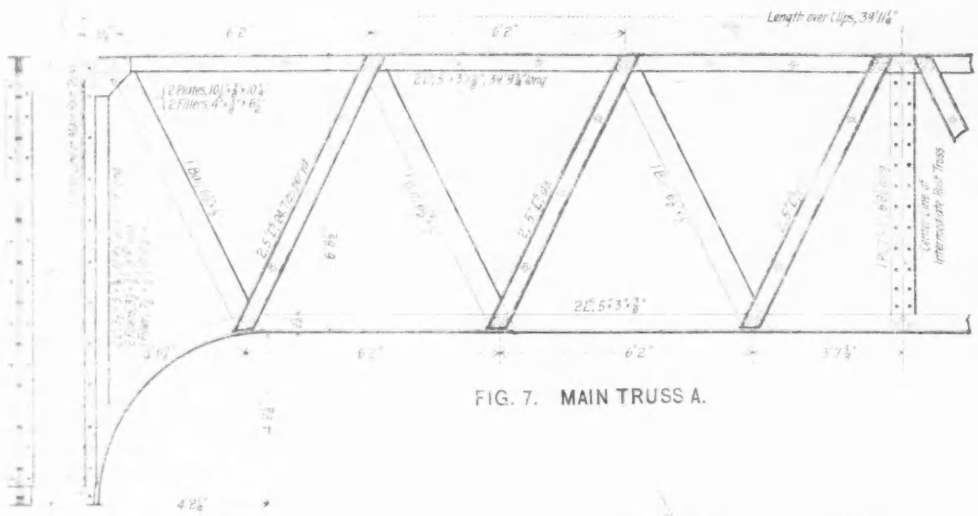


FIG. 7. MAIN TRUSS A.

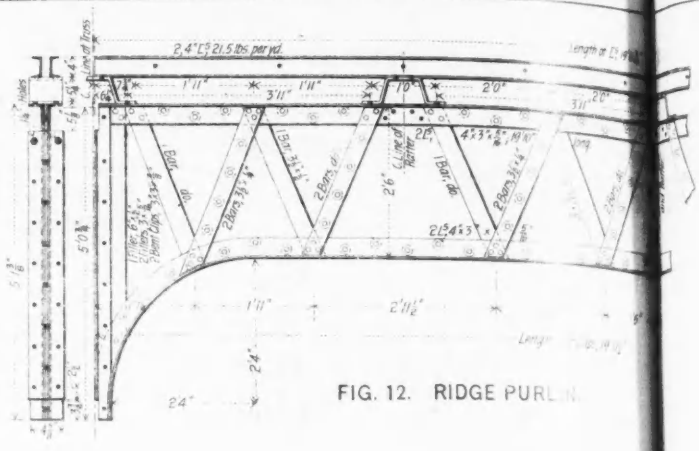


FIG. 12. RIDGE PURLIN.

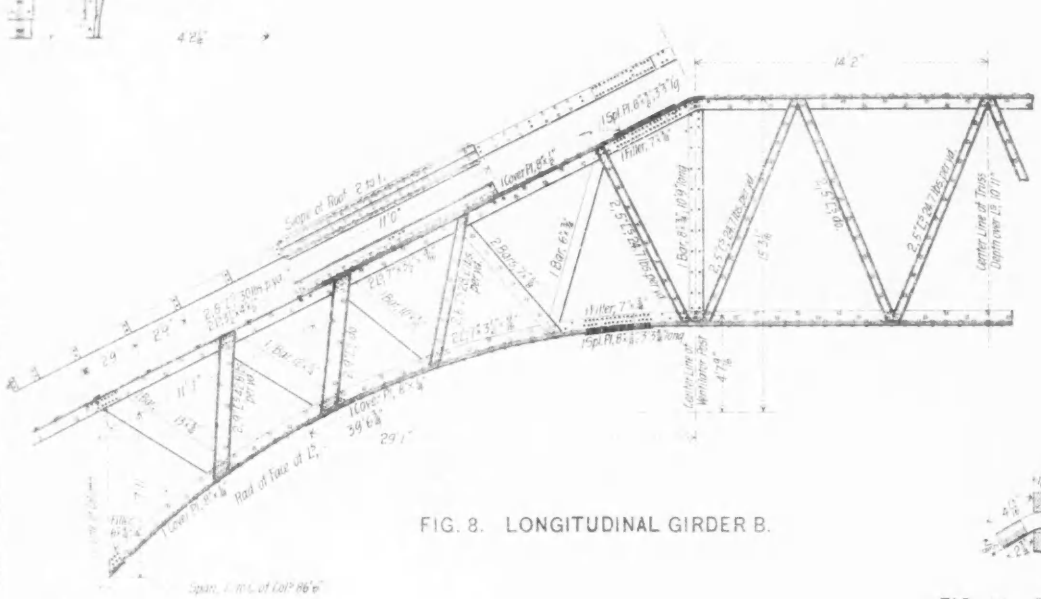


FIG. 8. LONGITUDINAL GIRDER B.

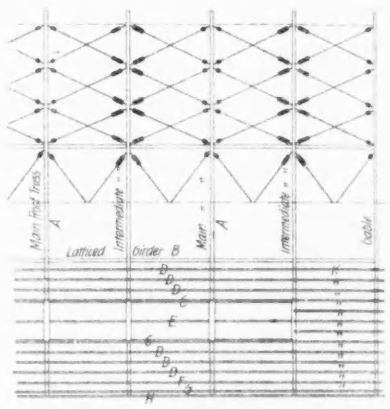


FIG. 9. PLAN OF PURLINS AND WIND BRACING OF MAIN ROOF.

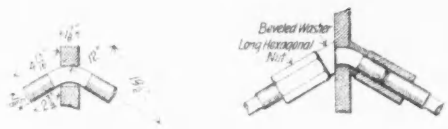


FIG. 13. DETAILS OF WIND BRACING CONNECTIONS.

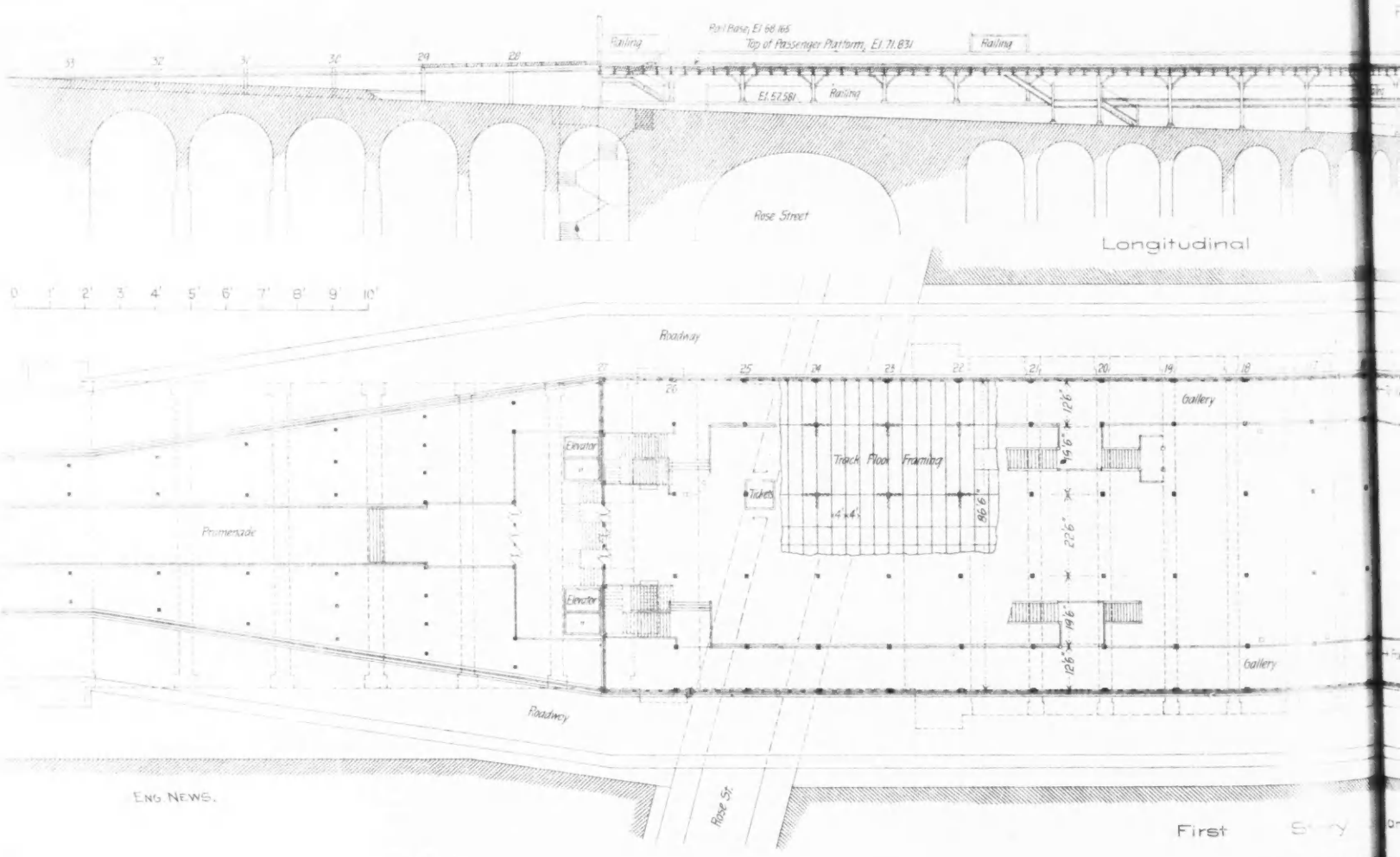
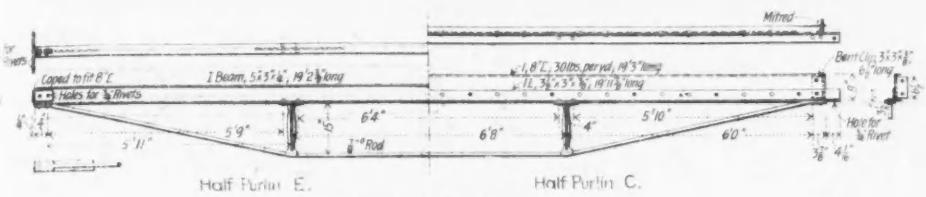


FIG. ELEVATION

NEW TERMINAL STATION AT THE NEW YORK EN

C. C. Martin, M. Am. Soc. C. E., C



Half Purlin E. Half Purlin C.

FIG. 10 PURLINS.

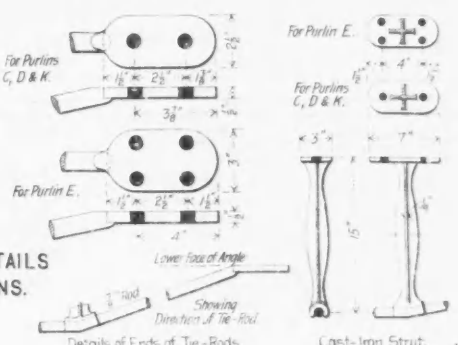
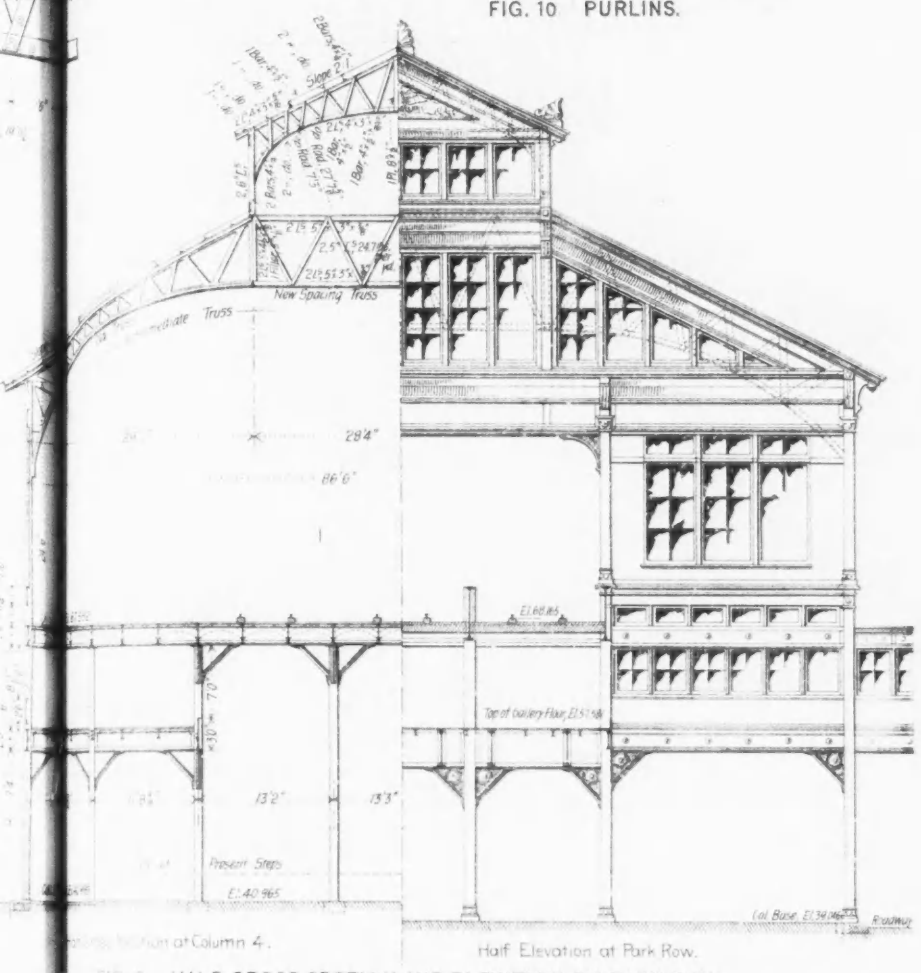

For Purlins C, D & K.
For Purlin E.
For Purlin E.
For Purlins C, D & K.
Lower Face of Angle
Showing Direction of Tie-Rod.
Details of Ends of Tie-Rods.
Cast-Iron Strut.

FIG. 11. DETAILS OF PURLINS.



Half Elevation at Park Row.

Section at Column 4.

FIG. 2. HALF CROSS SECTION AND ELEVATION ON PARK ROW.

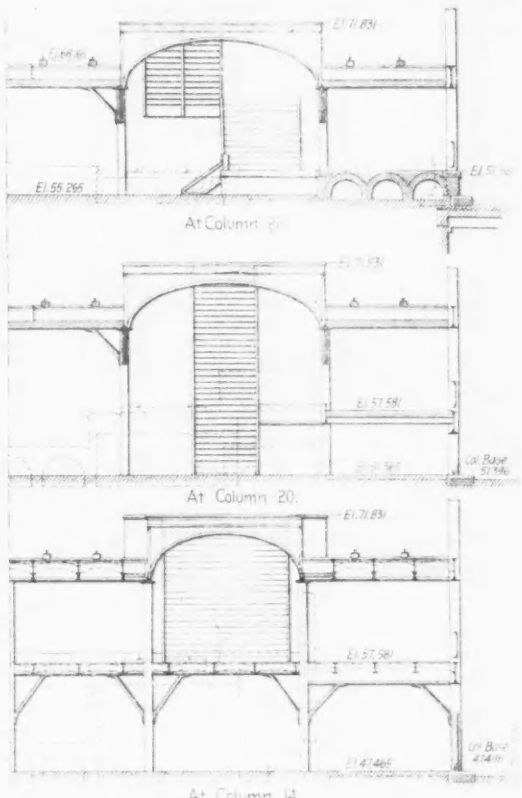


FIG. 3. HALF CROSS SECTIONS.

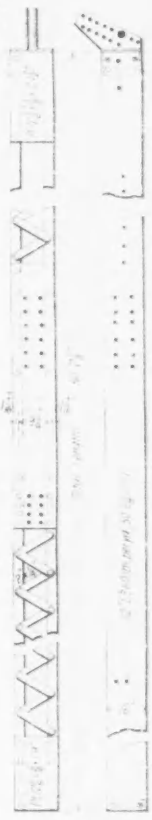
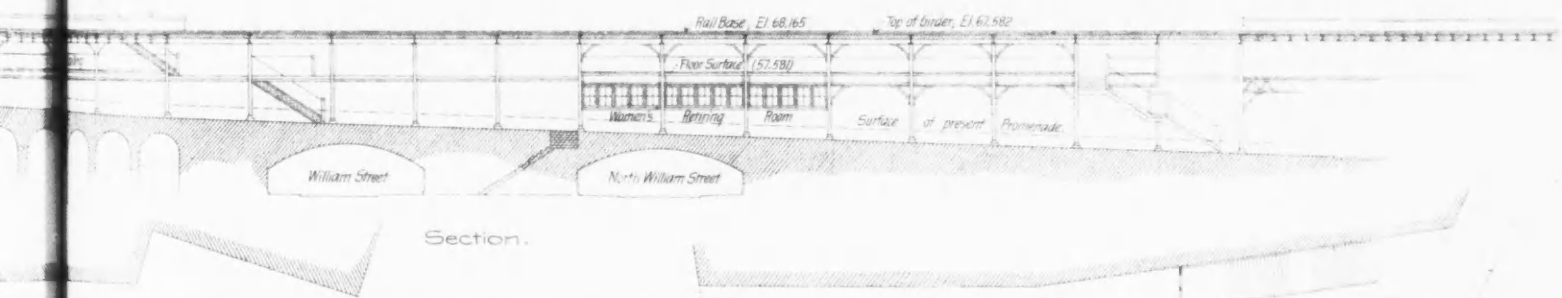
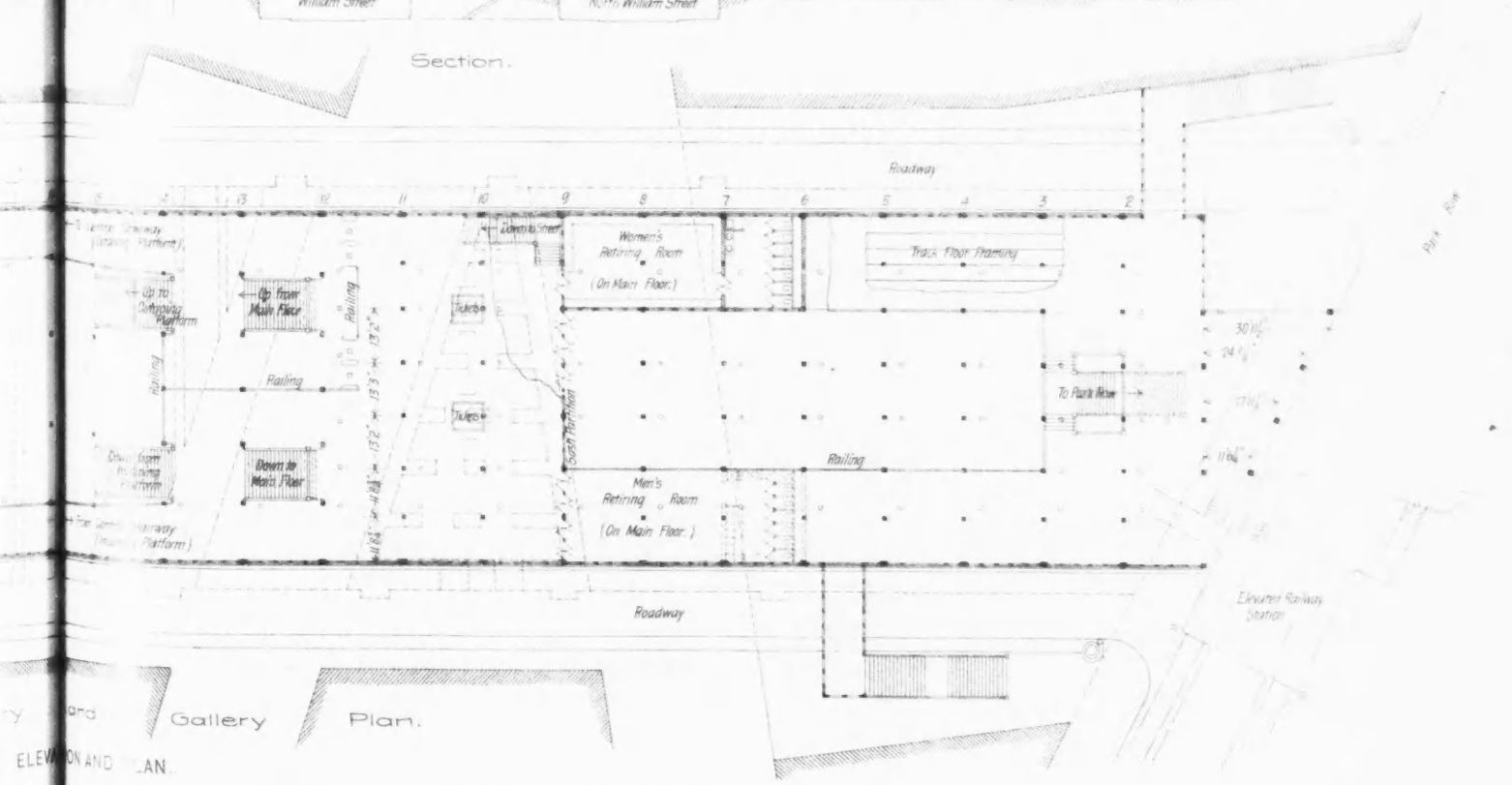


FIG. 6. COLUMN.



Section.



Gallery Plan.

ELEVATION AND PLAN

K END OF THE NEW YORK AND BROOKLYN BRIDGE.

E., Chief Engineer and Superintendent.

CHAS. HART & SONS, LITH., 24 VESEY ST., N. Y.

be available at all times. To obtain this end, they should be built of masonry so far as possible.

The section of the main canal should be provided with a sub-channel so that the ordinary flow can be concentrated. The bottom of the main and sub-channels should be paved or lined with brick or concrete, and the walls should be built of brick or concrete blocks. The drains delivering the water to the canals should likewise be built of masonry so far as and as soon as practicable. Earth canals, particularly when filled with rank vegetation, cause a reduced capacity over masonry-lined canals, which would, unquestionably, be at times a serious cause of flooding.

The whole system need not be built at one time. Certain parts may be constructed independently of others at the discretion of the city council, and it is capable of gradual extension, as may be required, without vitiating any part of the proposed plans. Neither in the built-up part of the city or outside of the same will it be necessary at any time to abandon or replace by others any of the recommended drains or canals unless some radical and extensive changes are made in the use of the territory for public purposes or new enterprises.

Storm relief canals, which need not be given their final size, nor be walled, lined or paved for years, can later be increased in size or supplemented by other relief canals, without difficulty or great expense if the accumulated results of observation of rainfall and run off in this city should require.

Pumps can be added from time to time as the amount of storm water which runs off the paved and impervious surfaces increases.

It will be practicable for the city engineer, Mr. L. W. Brown, to prepare sufficient material so that at our next meeting, approximately by Jan. 1, 1895, the board can, if it deems proper, recommend to the city council for their approval as ready for execution, all necessary plans for the more important parts of the drainage work.

To complete the labors of the advisory board further investigations relating to outlying districts must be made and various details perfected.

In connection with this work a complete topographical survey of the city has been made by Mr. L. W. Brown, City Engineer, and its mapping is nearly completed. Mr. Brown has also been making a careful study of rainfall and run-off. Six self-recording rain gages are so located as to divide the city into triangles. Mr. Brown has sent us a diagram, which is reproduced herewith, showing for the five months April to August, 1894, inclusive, the total precipitation within the city in millions of cubic feet, the delivery of the drainage pumps during the same period, the lift of the pumps, coal consumed and the duration of each rainfall. A second diagram, sent by Mr. Brown and plotted on the first by us, gives the rainfall during the period as recorded at the city hall. All the other factors shown by the diagram are for the whole city.

During the five months the total precipitation was 39.12 ins. Regarding some of the separate rainfalls, Mr. Brown writes us as follows:

> You will note that on April 24 we had a rainstorm on a thoroughly dry soil, no rain having fallen for 14 days previous. This rainstorm was an extraordinary one in intensity, there having fallen on that day 2.41 ins. in 70 minutes. You will also note a rainstorm which occurred on Aug. 13 on a thoroughly saturated soil. This latter storm was of perhaps unprecedented intensity, in that while 3 ins. of rain fell in eight hours, as shown by the diagram, all of this rain, excepting about 0.30 in., fell in one hour. Between 3.35 and 3:53 o'clock on Aug. 13, or in 18 minutes there fell 1.80 ins. of rain, or at the rate of 6 ins. per hour.

Mr. Brown states that so far as he knows these are the first accurate investigations of the sort conducted in that part of the country. The problem of drainage for New Orleans is a unique and difficult one, owing to the heavy rainfall, the flatness and low elevation of the city, the high saturation of the soil, and the necessity of huge drainage canals and pumps. For these reasons the final results of these investigations will be watched with much interest.

The Pacific cable project is being taken up again by the Australian and Canadian governments, and Mr. Sandford Fleming, M. Am. Soc. C. E., Canadian Commissioner, has just returned from a consultation with the Hawaiian authorities on this subject. The terms asked by the promoters for a cable via Honolulu are the lease of Bird or Necker islands for a mid-ocean station, with a 300-mile branch cable to Honolulu, and a Hawaiian subsidy of $35,000 per annum for 15 years. Hawaii, under its treaty with the United States, cannot grant to any other powers a lease or lien upon any of its territory, and it is said that it will appeal to the United States for the assent needed in this case.

THE NEW YORK TERMINAL STATION OF THE BROOKLYN BRIDGE.

(With inset.)

Work is now progressing steadily on both the new terminals of the New York & Brooklyn Bridge, and it is probable that within the course of the coming year the bridge authorities will be ready to put in service the new cable plant for operating the trains on the new gantleted tracks. At the New York terminal the roadways have been widened and the preliminary work has commenced on the new station building. At the Brooklyn terminal work is well advanced on the new station, which is quite separate from the old station now in use, and the roadways are being altered. General descriptions of the work have been given in our issues of Feb. 9 and April 20, 1893. The work is being carried out under the supervision of Mr. C. C. Martin, M. Am. Soc. C. E., Chief Engineer and Superintendent, and his assistants, to whom we are indebted for plans and specifications. The present article deals only with the New York terminal, but in a later issue we shall describe and illustrate the Brooklyn terminal.

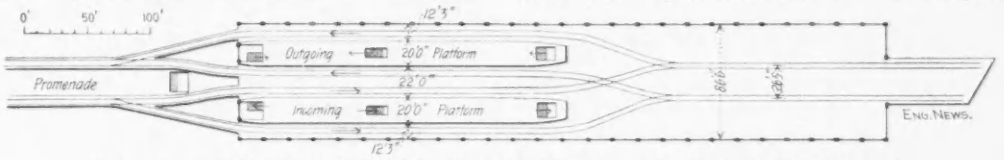


FIG. 4. PLAN OF NEW YORK TERMINAL STATION, BROOKLYN BRIDGE.

The reconstructed New York station will be located on the south side of Park Row and its site will include that of the existing station. It will have direct connection with the City Hall station of the Third Ave. elevated railway, and also, by the elevated passageway and stairways, with the north side of Center St., and by stairways and elevators with William and Rose Sts. The station will be rectangular in plan, 521 ft. long and 87 ft. 6 ins. wide, and will have, at the south end, a short elevated structure, over which the tracks will enter the station. There will be two main floors. On the first, or ground, floor will be retiring rooms and three ticket-sellers' boxes. On the second floor, placed longitudinally, will be two island platforms for passengers, and four tracks for the bridge railway. Between these floors, and leading back from Park Row about 260 ft., will be an intermediate floor, being in connection with the elevated passageway over Park Row and Center St. This floor extends to the outer end of the building by means of side galleries, 12 ft. 6 ins. wide. There will be one stairway from the first floor to the intermediate floor and six stairways from the first to the second floor. From the first floor to the sidewalk on Rose St. there will be two stairways, each enclosing elevators, and to the sidewalk on William St. there will be one stairway. Two stairways from Park Row, connecting with foot bridges over the roadway, will lead to the intermediate floor. The ticket offices on the first floor will be near the entrances to the stairways leading to the outgoing passenger platforms.

The bridge authorities will cut the openings through the masonry for the stairways and elevators leading to William and Rose Sts., prepare the masonry surface of the first floor for the concrete bed, lay the foundations for the brick walls and provide in place the piers and anchor bolts for the columns and the stairway stringers. They will also change and remove the tracks and remove the brick arches on the second floor of the existing station, and will also supply and put down the new tracks, and the sheaves, pulleys and other attachments for the hauling cables.

The contractors for the station building are Levering & Garrigues, of New York, whose bid was $240,629, exclusive of the elevators. The detailed prices of this contract were given in our issue of May 18, 1893. The first work to be done was to widen the roadways so as to allow the vehicle traffic to go on without interruption by the construction work. Beginning at a point about 650 ft. from Park Row, the masonry parapet wall on each side was removed and a structure of columns and plate girders erected, flaring outward from this point to the Park Row entrance, and making the width over all, between parapets at the entrance, about 126 ft. (measured on the square), instead of 100 ft., as formerly. The actual width of the roadway, however, will not be increased, but will be 16 ft. throughout, but it would have been well to increase the width at the entrances so as to reduce the liability of blocking the traffic, and also for the sake of a more imposing appearance.

The floor of the new roadway is of transverse I-beams and brick arches, with granite block paving, having the joints filled with gravel and tar. There is a low iron parapet, or, rather, a wheel-guard, surmounted by a strong railing of one 4-in. and three 3-in. tubes on heavy cast iron posts. This work was done by Smith & Ryan under contract. As soon as the roadways were completed traffic was diverted onto them, and openings were cut at two places in the old roadways and into the masonry of the arches of the approach, in which were set plate girders. These plate girders will carry two columns in the end of the new station, which are located directly over the arches. The masonry which has been removed or cut into was built with Rosendale cement, and both masonry and cement are proved to have been of very excellent quality.

Work has already been commenced on the erection of the ironwork of the new station building.

As shown by the longitudinal and cross sections, Figs. 1, 2 and 3, the present grade of the promenade will be lowered, so that the promenade runs out on the sidewalk level on Park Row, and the present awkward steps will be removed. The promenade, therefore, will be on practically the same grade as the roadway up to a point beyond the station, where the present grade of the promenade will be reached by a short flight of steps. Pedestrians will pass through the lower or main floor, which will be enclosed at the sides and south end, but will be unobstructed except by the waiting rooms and stairways. Passengers from the street going to the bridge cars will enter the main floor from Park Row, ascend any of the several stairways to the gallery floor and then ascend again to the platforms. Passengers from the elevated railway will be already on the level of this gallery floor.

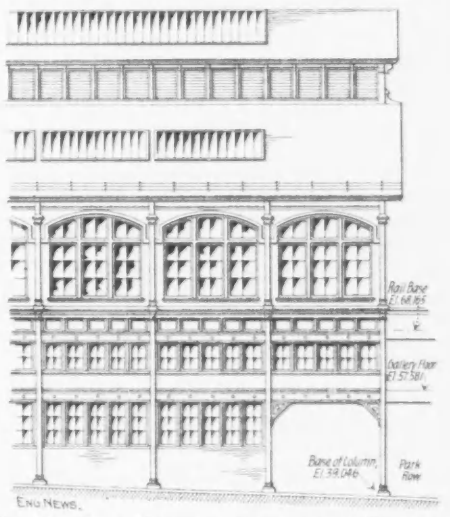


Fig 5. Part Exterior Elevation of Terminal Station, Brooklyn Bridge.

The grade of tracks in the station will be considerably above the present grade, and the tracks will enter the station by short approach viaducts of seven spans of 25 ft. each, having an up-grade towards the station of 1%. These viaducts are on either side of the promenade, and are built up of columns and girders with transverse beams and brick arches. The distance between tracks at this point is 29 ft. 9 ins. c. to c., and beyond the platforms (where the switching is done) it is 26 ft. 5 ins. The arrangement of tracks and platforms in the station is shown in the sketch plan, Fig. 4, the arrows indicating the direction of train movements.

The station is 521 ft. long and 87 ft. 6 ins wide, having six rows of columns, spaced 20 ft. c. to c. longitudinally. Transversely they are spaced 12 ft. 6 ins., 19 ft. 6 ins., 22 ft. 6 ins., 19 ft. 6 ins. and 12 ft. 6 ins. c. to c. There are 27 columns in each row. These columns carry six rows of plate girders, with transverse plate girders, 4 ft. c. to c., brick arches being placed between these latter and openings for floor lights being left at intervals. The exterior walls will be of steel framework with cast iron cornice and sills, substantially the same as the present station building, and the interior walls and partitions of brick, iron and glass. The general style of the structure and its exterior appearance are shown in Figs 2 and 5. The framing of the track floor is very simple. From Column 1 to Column 14, the transverse girders of each panel carry two lines of longitudinal girders, which, with the outer girders and those over the columns, make 22 lines of girders, spaced from 3 ft. 10⅝ ins. to 4 ft. 5 ins. c. to c., with 21 brick arches. From Column 14 to Column 27, the longitudinal girders over the columns carry transverse girders 4 ft. c. to c., with spaces as required for the stairways. On the approach viaducts outside the south end of the building the transverse girders are spaced 4 ft. 2 ins. c. to c. The general arrangement of the track floor system is shown in part on Fig. 1. Between the two tracks between the island platforms will be a floor light extending the full length of the platforms, and lighting the floor below.

The columns, Fig. 6, are built up of two 12-in. channels, 50 lbs. per yd., placed face to face and connected by lacing bars, ¼ × 2 ins., riveted to the outside of the flanges. Where connections with brackets, girders, etc., are to be made, 5-16-in. plates of suitable length are substituted for the lacing, and similar plates are also used in splicing existing columns to fit them for the new work. The roof will be carried by 27 roof trusses of 86 ft. 6 ins. span. Of these, 12 will be main trusses of the construction shown in Fig. 7, 13 will be intermediate trusses and 2 will be the gable end trusses. The intermediate trusses will be made from the trusses of the present station, each truss being cut at the middle and the two parts being moved apart and connected by a new spacing truss of 28 ft. 4 ins. span. Above these trusses are ventilator or monitor roof trusses of 28 ft. 4 ins. span. The arrangement is shown by Fig. 2.

The main truss A, Fig. 7, is 7 ft. 11 ins. deep against the column, and 15 ft. 3 1-16 ins. deep at the middle portion, which has the top and bottom chords parallel and horizontal. The top chord has a slope of 2 to 1 and the lower chord a curve of 39 ft. 6⅝ ins. radius. The roof trusses are connected by longitudinal trussed girders between the columns, one of which is shown in Fig. 8, and similar girders connect the trusses of the ventilator roof. There will be louvre ventilators in the vertical sides of the ventilator roof and glazed skylights on the slopes of the main and ventilator roofs, with main bars of steel channels, no soldering being required. The posts of the ventilator roof have the sides of 6-in. channels, 26.4 lbs. per yd., with a back cover plate ¼ × 6 ins. and 6 ft. 2 ins. long, and lacing bars ¼ × 1¾ ins. in front, except at the connections with the lower chord. The slope of the upper chord of the ventilator roof trusses is 2 to 1, and the lower chord has a radius of 27 ft. 7⅝ ins., except at the corners, where it is 7 ft. 3 ins. radius for an angle of 70° 59′ 20″. The depth of this truss at the center is 7 ft. 7¾ ins.

The height from grade of promenade at Column 4 (Fig. 2) to gallery floor is about 17 ft., and from the same grade to level of rail base on track floor is 27 ft. 6 ins. The height from rail base is 29 ft. 9 ins. to lower chord of main truss and 55 ft. to the top of the ventilator roof.

The arrangement of purlins is shown in Fig. 9. Each of the purlins C, at the sides of the skylight, consists of a single angle iron ⅜ × 3½ × 3 ins., trussed by a ⅞-in. rod, having flattened ends, riveted to the angle and the middle portion bearing against cast iron struts 6 ft. 8 ins. apart, the truss depth being 15 ins. To the back of the angle iron is riveted an 8-in. channel iron, 30 lbs. per yd., 19 ft. 3 ins. long. The ordinary purlins D are similar, but without the channel iron. Purlins E consist each of a trussed channel (instead of angle iron), 5 × 3 × ¼ in. Purlin F has struts of T-iron 4 × 2 × 5-16 in., 14¾ ins. long, the struts sloping 1 in 2 from the back of the angle iron so as to be vertical when the angle iron rests on the inclined chord of the roof truss. Purlin G is an angle iron with a plate ¼ × 7 ins. riveted to its back and depending 3½ ins. below its web. Purlin H is of Z section, built up of two angles 2½ × 2½ × 5-16 in. and a web plate 5½ × ¼ in., while to the top flange is riveted a cover plate ¼ × 10 ins. Purlins K of the end panels are similar to purlins D, but have the angle iron extending beyond the gable truss to carry the ornamental work, a ¼-in. gusset plate being riveted to the purlin and the face of the gable. The details of construction of the purlins are shown in Figs. 10 and 11. The purlins shown in Fig. 12 are for the ventilator roof, and form the ridge by which the roof light rafters are supported.

The arrangement of wind bracing is also shown in Fig. 9, and the details in Fig. 13. Short bent rods, 1 in., 1⅜ ins. and 1⅝ ins. in diameter, with threaded ends, are passed through the girders and are connected with the threaded ends of the brace rods by means of long hexagonal sleeve nuts, with beveled washers between the nut and the web plate of girder. In the gable ends the short rod passes at right angles through the plate, and has an ordinary washer and hexagonal nut on the outer side of the girder. The brace rods are ¾ in., 1 in. and 1¼ ins. in diameter, with the ends upset to 1 in., 1⅜ ins. and 1⅝ ins. diameter respectively for lengths of 4 and 4½ ins. With a few special exceptions, the rods and nuts have right-hand threads. All heads and nuts are hexagonal and the threads are of U. S. standard. The bent rods bear closely against the inner sides of the holes.

As this new station will cover the present smaller station, the construction will be a much more difficult matter than that of the Brooklyn station (which is entirely separate from the existing station, except at its north end), as it will be necessary to avoid interference with the traffic while building the station and rearranging the tracks. The tracks will have to be rearranged as required and temporary trestles and platforms provided during certain stages of the proceedings.

Along the lower margins of each roof there will be a gutter securely attached to the roof trusses and adjacent purlins and made tight with the roof. It will be in sections which are suitably inclined in either direction, and at each lower point of the main roof will be a tubular leader, reaching downward and discharging on the roadways or connecting with the sewer. The gutters may be so shaped as to form parts of the cornice. For the larger roofs they will be of cast iron and for the smaller they may be of sheet metal. The leaders may be of cast iron or of sheet metal. In the outer walls of the station the casing around the doors and windows and the panel work which fills the spaces about them, and the cornices and other work for architectural finish, will be of wrought iron or steel or of cast iron; in some places thin sheet metal may be used.

Along the lower margin of each main roof will be a railing or snow guard, consisting of three lengths of coupled ¾-in. pipe, 6 ins. apart, passing through posts of bars ½ × 4 ins., placed not more than 6 ft. apart, and which will be fastened to the roof trusses and purlins or to the gutter, and well braced. The pipes, posts and connections will be of wrought iron.

The steel used is specified to be of a suitable and uniform quality, known as mild steel, and incapable of tempering; it must have an elastic limit of not less than 35,000 lbs. and an ultimate tensile strength of not less than 65,000 lbs. per sq. in. In the several parts, except rivets, under tensile strain, it must stretch not less than 20%, and samples ¾ in. square must, without crack or flaw, stand bending cold 180° around a rod ¾ in. in diameter. In rivets under tensile strain it must stretch not less than 25% in 8 ins., with a reduction of the fractured section not less than 35%, and samples ¾ in. square must, without crack or flaw, stand bending cold 180° around a rod ¾ in. in diameter and back again. The wrought iron must be tough, fibrous and uniform in quality, having an elastic limit of 24,000 to 26,000 lbs. and an ultimate tensile strength of 48,000 to 50,000 lbs. per sq. in. of section. Under tensile strain it must stretch from 10 to 15% in 8 ins. The higher limit is required for rods, arch ties, rivets and angle plates made of wrought iron.

The rivets in the girders, columns and roof trusses, which are shop driven, are to be of steel; for attaching beams to girders, and for other connections, they will be of wrought iron. The rivets will generally be ¾ in. diameter, but some will be ⅞ in. The rivet holes may be punched or drilled; if punched, the work must be carefully done with well-proportioned dies and punches, without distorting the piece, and so that the holes will be straight, clean and cylindrical; if through steel, in whole or in part, the holes must afterwards be reamed to size and not less than 1-16 in. thickness of metal removed. When the pieces to be joined together are assembled, the holes for each rivet must be strictly in line, normal to the surfaces and of diameter exceeding that of the rivet not more than 1-16 in. If a slight misfit should occur, the holes must be reamed truly to the required size, and the rivets be driven without separating the parts. No drifting will be allowed, and, wherever practicable, the rivets will be machine driven.

The existing station is to be removed in sections as the erection of the reconstructed station progresses, and the parts and material taken down, so far as such may be available, are to be incorporated in the new structure.

The metal frame of the vertical walls which enclose the first floor is filled in below the windows with brick, and the partitions separating the retiring rooms from the large enclosed area and from each other are also of brick. Each will be a wall 8 ins. thick, on a foundation laid by the Trustees up to the proper level, and will be well anchored to the metal frame and to the second story girders and beams. Sills or platforms and steps of granite, 8 ins. thick, not les than 14 ins. wide, and in blocks not less than 5 ft. long, may be required, and will be cut square and straight with one side and edge fine axed.

The spaces between the girders and beams in the second floor systems are to be filled with arches of brick or terra cotta, so laid as to enclose the arch ties. The arches of brick will be 8 ins. and 4 ins. thick, and generally will rise about 9 ins. at the crown. They will be turned on centers, made with slats so placed as to receive in the spaces between them the longitudinal arch joints.

A bed of calcareous concrete will be laid and finished with a uniform plain surface over the haunches of the floor arches and not less than 1 in. deep at the shallowest place (exclusive of rivet heads in the girders covered), over the entire area of the first floor, including ramps, not less than 2 ins. thick, and over the sidewalk along Park Row not less than 6 ins. thick. In this, within the walls of the retiring rooms, strips of wood, to which the flooring is to be nailed, 3 ins. wide and 2 ins. thick, and not more than 16 ins. apart between centers, will be firmly bedded 1½ ins. deep, and with the upper surface strictly in one plane. Upon this bed, exclusive of that within the retiring rooms, will be laid a covering of bituminous concrete not less than 1 in. thick, finished (with a crown on the passenger platforms) strictly to grade and outline, and with shallow gutters at the margins of the floors and elsewhere as directed by the engineer. The outer ends of the sidewalk, when finished, must be straight and nearly vertical.

Wherever required, the otherwise unprotected, projecting lower flanges of the girders and beams will be covered with not less than 2 ins. of fireproofing or mortar, held in place by wire netting folded around the exposed flanges and nailed to the floor arches by strips of hook iron hooked over the flanges every 4 ins. or by other suitable means. To aid in holding the fireproofing, the arches will be set or cut back not less than ½ in. from the edges of the flanges. A small part of the ceilings and walls in the retiring rooms and elsewhere may be covered with a coat of brown plastering, followed by one of white, hard finish, with cornices and ornamental pieces as directed.

The roofs will be covered with slates, of an even tint and a uniform size, 8 ins. wide and 16 ins. long, with the lower corners clipped off so as to form a hexagonal outline. They will be laid over waterproof tarred roofing felt on a board roof.

The brick for the inner faces of the water closet walls, up to the line of the window sills, will be enameled, of kind and colors to be approved by the engineer; for the remainder of these walls and for the other walls they will be the best Philadel-

phia brick, dark and uniformly tinted; and for the floor arches they will be of the kind known as Colabaugh O. K. All the brick used will be selected as to color, size and finish, well burned and without spawls or other defects. The granite used will be dark and uniform in color, of sound, clear stock and free from imperfections. The slates used are to be from quarries of well-established reputation and to be of the best quality; no rough, warped, chipped, cracked or broken slates being allowed, and all such found on a roof will be replaced by others free from these defects. The sand used will be clean and sharp, and the broken stone will be clean and in fragments which will pass through a ring 1½ ins. in diameter. The best Rosendale cement, or a brand equally good and approved by the engineer, is to be used; and from a mixture of about four parts of cement and one of water by weight, balls 3 ins. in diameter, exposed ten minutes in the air, must harden without cracking or falling down. Specimens molded to proper shape and exposed 24 hours in the air must stand a tensile strain of not less than 60 lbs. per sq. in. of section.

The mortar used in laying brick or stone is to be made of one part cement and two parts sand. The calcareous concrete used for the beds over the arches and underneath the floor and sidewalk surfaces will be made of one part cement, two parts sand and three parts broken stone. In each case the several parts must be well intermixed before water is added. The bituminous concrete used is to be of Neuchatel mastic, or similar material equally good in quality and approved by the engineer. The fireproofing used will be made of three parts coal ashes, two parts fine sand and one part plaster of Paris, fine, clean and well intermixed. A different compound, if equally refractory and effective, may be substituted for this upon approval of the engineer. No work specified under the head of masonry is to be done in cold or frosty weather, except upon approval of the engineer.

There will be two passenger elevators, located at the south end of the station, and connecting the first floor with the street level at Rose St. Each will have two passenger platforms, about 10 × 6 ft., suitably enclosed and placed side by side, arranged to counterbalance, one platform to ascend as the other descends, and to receive and discharge passengers at either end of each. The maximum load on a platform will be 20 persons, or 2,800 lbs.

PERSONALS.

Mr. James M. Phillips has resigned his position as General Superintendent of the Kentucky Union Ry.

Mr. R. T. Goff has been appointed General Superintendent of the Jacksonville, St. Augustine & Indian River Ry.

Major James B. Quinn, Corps of Engineers, U. S. A., has been assigned to the U. S. Engineer Office, at New Orleans, La.

Mr. Z. D. Lancaster, of Pittsfield, Me., has been elected President and General Manager of the Sebasticook & Moosehead R. R.

Col. A. H. Waterman, who was chief construction engineer of the Panama Railroad, died at his home in Chicago, Oct. 27, at the age of 70.

Mr. A. Mordecai, M. Am. Soc. C. E., has been appointed Assistant Chief Engineer of the New York, Lake Erie & Western R. R. and Chicago & Erie R. R., with office at Cleveland, O.

Mr W. L. Stebbings, Chicago, has been engaged as consulting engineer by the Chicago Dock Co. to design a viaduct 600 ft. long, to form a passageway for vehicles to its warehouses on Taylor St.

Mr. Henry C. Phillips, an American engineer employed on the construction of the Mexican Southern Railway between Oaxaca and Pueblo, was robbed and killed by brigands recently near Las Vegas.

Capt. George McC. Derby, U. S. Engineers, Assistant to Major Miller, Engineer Commissioner of Washington, D. C., has been transferred to New Orleans, La., and will be succeeded by Capt. L. H. Beach, now of Galveston, Tex.

Mr. V. E. McBee, formerly Superintendent of the Richmond & Danville R. R. lines in North and South Carolina, has been appointed General Superintendent of Transportation of the Seaboard Air Line system, with headquarters in Atlanta, Ga.

Mr. H. R. Nickerson, Assistant General Manager of the Mexican Central Railway, has been appointed General Manager, vice Mr. E. W. Jackson, who has resigned his position as Vice-President and General Manager to accept a similar position on the Interoceanic Railway of Mexico. Mr. Nickerson's office will be in Mexico.

Mr. C. W. Buchholz, M. Am. Soc. C. E., has been appointed Chief Engineer of the New York, Lake Erie & Western R. R., and Chicago & Erie R. R., with offices in New York. Mr. Buchholz resigned this position in October, 1892, to become President and Chief Engineer of the Quaker City Elevated R. R., of Philadelphia. The construction of this road was prevented by legal complications.

Mr. Hudson Maxim, Manager of the Maxim Powder & Explosives Co., and inventor of the "maximite" explosive described in our issue of April 27, 1893, had his left hand blown off at the company's works near Farmingdale, N. J., by the explosion of a disk of fulminate compound which he was holding in his hand and which was set off by a spark from another piece with which he was experimenting.

Mr. V. G. Bogue, M. Am. Soc. C. E., of Chicago, Ill., has been employed to prepare a general plan for a union terminal at Seattle, Wash., and also to design a street and dockage system, which it is proposed to lay out on the tide flats and water front of that city. The plans are to be accompanied by a full report. This work is being done for the Board of Tide Land Appraisers, under an act of the Legislature.

Mr. Jas. R. F. Kelly, M. E., and Mr. Gustav Triest, Jun. Am. Soc. C. E., have formed a partnership under the name of Jas. R. F. Kelly & Co., engineers and contractors, with offices in the Havemeyer Building, New York. Mr. Kelly has until recently been partner of Joseph Edwards & Co., machinists, of New York city, and Mr. Triest has been assistant to Mr. Alfred P. Boller, M. Am. Soc. C. E., for the past five years.

Mr. Charles A. Sheldon, Assistant Division Superintendent of the Michigan Division of the Lake Shore & Michigan Southern Ry., has resigned in order to accept a position with the Consolidated Car-Heating Co., of Albany, N. Y., and will have charge of the compressed gas lighting department of the company, which is about to introduce the Pope system, interchangeable with the Pintsch system of gas lighting for cars, etc.

Mr. Frederic E. Strom, C. E., of Brooklyn, N. Y., has been decorated with the Legion of Honor by the French government for his system of submarine tunneling, described in our issue of Feb. 28, 1891. The late President Carnot appointed a commission of engineers to examine into and report upon proposed plans for crossing the English channel, and the plans of Mr. Strom were recommended. The same system is also being recommended by M. Delaggio, late Minister of Public Works of Turkey, as a means of crossing the Bosphorus.

Mr. Milo W. Locke, contractor, of Baltimore, Md., died at Palatka, Fla., Nov. 1, at the age of 64. He was a native of Syracuse, N. Y. After the war he took a contract to build part of the second track of the Philadelphia, Wilmington & Baltimore R. R., and also constructed the Delaware Breakwater at Lewes, Del. From 1869 to 1885 he was a resident of Baltimore, and built the abutments of Jones' Falls, the bridges over the falls at Eager and Charles Sts., and did the masonry work on the bridges at Calvert, Baltimore and Lombard Sts. The Union tunnel was built under his direction, and he also built the iron lighthouse in Craighill channel. From Baltimore he removed to Wilmington, Del., where he was connected with the Brandywine Granite Co., and with Gen. R. Snowden Andrews he built the Baltimore & Ohio R. R. bridge over the Brandywine. During the last two years he had been a member of the contracting firm of I. H. Hathaway & Co., of Philadelphia, and superintended the jetty work on the St. John's River, at Mayport, Fla.

Mr. Edwin Clark, M. Inst. C. E., whose name is associated with the Britannia and Conway tubular bridges, died at Marlow, England, Oct. 21. He was born at Marlow in 1814. He worked under Robert Stephenson, and as resident engineer had control of the construction of the Britannia tubular bridge, his brother, Mr. Latimer Clark, being his assistant. After the completion of the Britannia and Conway bridges, he wrote the well-known book on these structures, in which he was assisted by his brother. The Britannia bridge was begun in May, 1846, the first of the great tubes was lifted on June 23, 1849, and the first locomotive ran through in 1850. He was associated with Fairbairn, and carried out under him the celebrated experiments on the strength of materials, and of girders and girder tubes. He was elected an Associate of the Institution of Civil Engineers in December, 1850, and was transferred to the class of Member in April, 1855. He contributed papers to the Proceedings, on "Hydraulic Lifting Graving Docks," in 1866, and on "Engineering Philosophy and the Durability of Materials." For many years he was chief engineer to the Electric Telegraph Co., and an interesting pamphlet exists describing his proposals for signaling by electricity on the London & Northwestern Ry. He patented the hydraulic graving dock and the hydraulic canal lift, and was one of the inventors of the block system of railway signaling. He constructed the harbor of Callao, in Peru, and carried out engineering works in various parts of the world, and in connection with the Anderton canal lift an important report by him exists on the causes of failure of some of the great lift cylinders in 1882. Retiring in 1876, he settled down at Marlow.

NEW PUBLICATIONS.

(Any book noticed in this column of which the price is given will be sent postpaid by Engineering News Publishing Co. on receipt of the amount stated. This does not include publications issued by the Government, by states or cities, by societies, or trade publications. For copies of these, application should be made direct to the address given in the notice.)

NOVEMBER MAGAZINES.—The summer meeting of the British Association for the Advancement of Science was held this summer at Oxford, and was the occasion of an address by Lord Salisbury, the President of the Association, which was of such interest from both the literary and the scientific standpoint that it deserves to be carefully read by every man who aims to keep in touch with progress in the broader fields of science. We debated the question of reprinting it in this journal, but its matter was hardly within the limits of our field, and the necessary space could not well be spared. We are, therefore, much pleased to note that the "Popular Science Monthly," in its current issue, prints the address in full under the title "Unsolved Problems of Science." The editorial department of the number contains a very partisan and unjust criticism of the address; in fact, the editor betrays the fact that bigotry concerning the accepted scientific dogmas of to-day may be quite as strong and bitter as bigotry concerning religious dogma. In other respects this number of the Monthly is a particularly good one. Prof. Angelo Heilprin, of the Peary Arctic expedition, writes on the "Glaciers of Greenland," and the article is illustrated with a number of excellent half-tone engravings from photographs. Mr. C. H. Henderson, of the Philadelphia Manual Training Schools, writes on "Manual Training." As many of our readers probably know, Philadelphia takes a high rank in this department of educational work. An article of greater novelty is a description of the Swiss Watchmaking schools, in which boys are trained to become expert watchmakers. We have absolutely nothing on this side of the Atlantic to correspond with the laborious and thorough education of skilled workmen which is effected in these Swiss watch schools. It is not too much to say that they are the corner-stone of the Swiss watch industry.

In the "North American Review" Hon. H. A. Herbert, Secretary of the Navy, writes on the recent China-Japanese naval battle off the mouth of the Yalu River. The Secretary contends that the events of that battle proved nothing with respect to the relative merits of battleships and fast cruisers, or thick armor and high speed. The war is discussed from a political point of view by the Japanese Minister to this country. The idea of a commercial or political alliance between Great Britain and the United States is again brought forward, and is discussed by Captain Mahan, of the U. S. Navy, and Lord Charles Beresford, of the British Navy. Both the distinguished officers admit that desirable as an alliance between these nations would be from some points of view, it is far from likely to be effected for a long time to come. Lord Beresford, however, thinks it might be practicable for the two nations to form an alliance for the protection of those commercial properties in which both countries are equally interested. The number closes with a symposium on "The Business Revival," by the Presidents of the Chambers of Commerce of Boston, Cincinnati, New Orleans and St. Louis. The general tone of these opinions is to the effect that a healthy revival of business is certainly in progress and is likely to continue unless uncertainty of legislation should beget another epidemic of distrust among business men.

"Harper's" opens with a paper by Thos. A. Janvier on the "Sea Robbers of New York," which we note especially because it overturns the long-cherished notion that Captain Kidd was the chief of piratical chieftains, and gives the actual history of this famous old sea rover, who appears to have been by no means so black as tradition has commonly painted him. Edwin Lord Weeks describes his impressions of Rajpootana, the portion of India where England's influence has had least effect in eradicating ancient customs. It may interest American freight agents to know that passengers on Indian railways are so fond of carrying their live-stock with them that special rates have to be charged. According to the schedule, "Tiger, panther and cheetah cubs in cages are carried at double the dog rates for each animal."

In "Scribner's" Col. H. G. Prout describes "English Railway Methods" in a manner most entertaining and instructive. His analysis of the financial management

of English and American railways deserves especial mention, as he touches here on what is doubtless the weakest point in our American railway system.

In "The Century" is begun a new "Life of Napoleon Bonaparte," with illustrations of the greatest historical interest. A paper on how the Chinese work and live in the city of Canton is an accurate photograph of daily life in the Flowery Kingdom, which will be read with interest just now, when the China-Japanese war attracts public attention so much in that direction. In the editorial department "Congress and the Forestry Question" is discussed, and Rev Washington Gladden writes an "Open Letter" on "The Government of Cities." In "The Forum" Rev. J. W. Dike writes on "The Wage Earners' Loss During the Industrial Depression." His investigation is confined to Massachusetts, and shows that in the last three months of 1893 the number of persons employed in the manufacturing industries of the state was seven-eighths of the number employed in the busiest quarter of 1892. He thus points out, what is too often forgotten, that the effect of panics and hard times is more or less exaggerated; and that though stocks go up or stocks go down, the great industrial processes which supply the staple necessities of life go steadiliy on.

METHODEN UND RESULTATE DER PRUEFUNG DER HYDRAULISCHEN BINDEMITTEL. Zusammengestellt von L. Tetmajer, Professor am Polytechnikum in Zurich. Published by the Institute in Zurich, 1893. 8vo; paper; pp. 398; 34 illustrations; 8 plates; 1 geologic map; numerous tables.

It has become apparent within the last few years that the field of usefulness for good concrete may be considerably extended. A marked interest in the subject is shown by engineers and manufacturers in this country, and evidence is not wanting that the latter are alive to the opportunities, and actively preparing their works to furnish a high-grade cement. Excellent records have in the past been made by American cements, but what is wanted before any cement can be able to command absolute confidence as a building material is the assurance that its superiority is both uniform and constant. It is not enough to know that any particular brand has in any particular case given good results; we must be satisfied that each brand is made to-day by a process which insures that the product is constantly kept up to a uniform standard of excellence, and to do this a rational and complete system of inspection and tests is a necessity. If concrete is to take the place of steel in our structures to any extent, it must be subjected to as thorough and rigid an examination as is applied to the latter material both in manufacture and construction.

In this connection it is both interesting and useful to carefully study the methods used in testing hydraulic lime and cements at the laboratory of the Polytechnic Institute in Zurich, by so eminent an authority as Professor Tetmajer, under whose direction the tests have been made. The laboratory is established for the purpose of testing all kinds of building material, and the present volume is No. 6 in the general series of publications, and treats exclusively of cements. The treatise was commenced some ten years ago, but owing to the pressure of other business upon the laboratory, the author was compelled to put it aside until recently. He now publishes his extended and revised experiments. subject is divided into three chapters. The first chapter treats of the raw materials used in manufacturing hydraulic lime and cements; namely, limestone, clay and various fluxes having hydraulic properties; the geological origin and localities of different clays are separately discussed. The chemical methods used are of a very comprehensive character,involving an analysis to determine the acids, alkali, amount of moisture, reduction through burning, etc. The methods of Lunge and Dietrich for determining the amount of carbonic acid are described and illustrated; the first of these giving results directly. As final tests, burning and slaking are used, as also the determination of hardening and setting properties; the materials are tested for tensile and compressive strength in a sand mixture of 1 to 3 after 7 and 28 days' exposure in air and water.

The second chapter treats of hydraulic lime, Roman cement, Portland cement, hydraulic fluxes, Pozzulano cement and mixed cements, and the chemical and physical methods used in testing these. Generally, the cements are divided into two groups—those that harden independently, that is, at ordinary temperatures, and with or without the admission of air; and those that do not harden without the presence of carbonic acid. Their hydraulic qualities are then rated according to their non-solubility in water. They are analytically examined as to chemical and physical structure, color and foreign substances; then follow the different methods of testing which form the essence of this book, and which may be enumerated as follows: Determination of weight, expansion and contraction, constancy of volume, setting properties, effect of temperature changes, fineness, porosity, permeability to water, wearing qualities, tensile and compressive strength and frost-withstanding qualities.

The weight is determined both per volume under different conditions and specifically; the latter by the aid of the volumeters of Michaelis, Schumann and Erdmenger; for measuring expansion and contraction Bauschinger's instrument is used. The various tests for examining the constancy of volume are carefully described. The cement is boiled 6 hours in a bath of steam at atmospheric pressure; for this test the material is rolled into balls, as it also is for the test where it is heated over a gas flame to red heat. Other tests under this head are the dry and moist oven tests, and the tests for exposure in air and under water. Of special interest are perhaps the tests relating to the setting and hardening properdies of the material, as well as to its consistency. A self-recording instrument by Amsler is used. It records graphically the interval of time between the application of water to the cement and the commencement of setting, and, further, the interval from this point until hardening takes place. These different phases are determiued by the penetration of a falling needle. The curves described by this instrument are shown on the plates, and a record of temperature changes is given, as well as the periods of setting and hardening at different temperatures.

Various machines of different capacity for testing the tensile and compressive strength are used, special mention being made of the Swiss normal pressure machine, where the test piece is constantly in view. The pressure is applied through a screw, and either the total pressure or that per sq. cm. may be read off directly. The test piece is broken in from 1 to 1½ minutes. These pieces are prepared in a special ramming machine, by which it is possible to make them all of a certain,but arbitrary, thickness and consistency. Tests for transverse strength do not appear in the present volume; it is, however, expected that the laboratory will undertake a series of tests for the purpose of determining the strength of various concretes and their constructive qualities, and it is to be hoped that investigations of transverse strength will be made in this connection. All tests are carefully described and many instruments are illustrated. The tests for constancy of volume are illustrated on the plates by a number of photographic views showing different conditions of the test pieces; also the effect of blowing is similarly illustrated for Portland and slag cements. In the third chapter the results of the investigations are tabulated.

REPORT ON INTERLOCKING AND SIGNALING IN GREAT BRITAIN.—Returns by Railway Companies to the Board of Trade for the year ending Dec. 31, 1893. Paper; 4to; pp. 105.

This report contains the usual tabular statements of the extent of interlocking plant, which may be summarized as follows:

	England and Wales.		Scotland.		Ireland.		Total.	
	1893.	1892.	1893.	1892.	1893.	1892.	1893.	1892.
Signals and switches interlocked	35,462	32,630	5,636	5,412	2,211	1,958	41,309	40,000
" " " not interlocked	412	706	176	434	160	260	748	1,356
Percentage interlocked	99	98	97	93	93	90	98	97
Mileage of double track	9,204	9,167	1,271	1,267	613	609	11,088	11,043
" " " worked on absolute block	9,188	9,103	1,269	1,265	591	585	11,048	10,953
Percentage so worked	99.8	99.5	100	100	96	96	99.6	99.2
Miles worked by permissive block, double-track	3		.....		.....		3	
Miles of single track	4,385		1,656		2,371		8,423	
Miles single track worked by telegraph and train staff on absolute block system	2,510		197		509		3,216	
Miles of single track worked without train staff	43		258		1		303	
" " " " " with electric train staff or tablet	1,455		650		1,348		3,453	
Miles single track worked by train staff, but not by absolute block	29		.....		.....		29	
Miles single track worked, one engine allowed on line	218		427		153		798	
Miles single track worked by train porter system	¾		1		¼		2	
" " " " " train staff, with tickets	56		94		317		467	
" " " " " " " without tickets	85		26		45		156	

TABLES AND DIAGRAMS FOR THE USE OF ENGINEERS AND ARCHITECTS. By William W. Crehore, Assoc. M. Am. Soc. C. E. Fifteen separate tables and explanatory text. Published by Engineering News Publishing Co., and the author, at 39 Cortlandt St., New York. Each part 25 cts.

These tables and diagrams are intended to facilitate the calculation of framed structures in metal and in wood. The diagrams and tables are blueprints from originals worked out by Mr. Crehore, and a general index sheet gives a long list of problems, with certain values known, and refers to the particular diagram furnishing the solution. With each table or diagram is a sheet of printed text explaining their use. Among the problems to be solved by the use of these sheets may be mentioned the following, as giving some idea of the purpose of these tables: Uniformly distributed column and beam loads; deflection due to maxima loads, for various spans up to 45 ft. and under eight combinations of modulus value and allowable fiber stress; depth of web plates in beams and girders under various conditions of loading, etc.; flange area required for given load per linear foot; length of flange plates required; maxima bending moments, end shear and panel load for three standard systems of loading; safe uniformly-distributed load for wooden stringers and joists; sectional areas and weights per linear foot of square, rectangular and round cast iron columns of various thickness of metal; safe load for rectangular wooden posts; bearing and shearing values of rivets and bolts for plates of different thicknesses, etc. Most of the tables have been checked by Thacher's calculating machine, and they are sufficiently exact for rapid estimating and designing. The figures are very plain and easily read, and their issue in separate sheets makes them very convenient for office use.

PROCEEDINGS OF THE ASSOCIATION OF ONTARIO LAND SURVEYORS, At Its Second Annual Meeting Since Incorporation. Held at Toronto, Feb. 27 and 28 and March 1, 1894. Secretary, A. J. Van Nostrand; Toronto. Paper; 8vo; pp. 170; illustrated.

This volume contains the reports of committees, addresses, notes of proceedings, etc., and the following papers: "The Eskimo," J. W. Tyrrell; "House Drainage," M. W. Hopkins; "The Lake of the Woods as a Mining Camp," Henry De Q. Sewell; "Annuities," M. J. Butler; "Genesis and Development of Mining in the Sudbury District," John D. Evans; "Pelee Island Drainage Works," William Neuman; "The Grand Bend Cut," R. Coad; "Little Bear Creek Drain," W. L McGeorge; "Nipissing & James Bay Railway Survey," J. A. Patterson; "Descriptions of City Properties," T. B. Speight; "Regulation Mile Track of the Windsor Driving Park Association," Owen McKay; "Photo-Topography," Otto J. Klotz; "Cedar, Macadam and Gravel Roadways," P. S. Gibson; "Protection of the Source of the Owen Sound Water Works System," R. McDowall.

A MANUAL OF SURVEYING INSTRUCTIONS, for survey of the public lands of the United States and private land claims. Prepared in conformity with law, under the direction of the Commissioner of the General Land Office. June 30, 1894. Washington, D. C., Department of the Interior. 8vo; cloth; pp. 236; with many folding maps.

This useful publication, or the "Manual of 1894," as it is officially called, is issued as a guide to all surveyors of public lands in the United States, and they are required by law to comply with its instructions. The work commences with the history of legislation for surveys, in 1784, and continues with the existing land laws. Minute directions are given regarding the system of rectangular surveying, the instruments and processes to be used. Very considerable space is devoted to the annual change of the magnetic declination within the limits of the United States; with tables of secular and annual variation, azimuth, etc., useful to the land surveyor. Specimen field notes are given for various classes of work, and a series of folding plates and maps illustrates the text.

ELEMENTARY PRINCIPLES OF MECHANICS. Vol. I. Kinematics. By A. Jay Du Bois, C. E., Ph. D., Professor of Civil Engineering in the Sheffield Scientific School of Yale University. First edition. New York: John Wiley & Sons. 8vo; cloth; 231 pp.

This latest text-book on kinematics, or that branch of science treating of the measurable relations of time and space only, embodies in one volume an abridged course and matter intended for advanced students. Under three section heads we have the general principles of the science of kinematics; the kinematics of a point and the kinematics of a rigid system. Each one of these is treated in detail under separate chapter heads, illustrated by appropriate diagrams, and each closing with examples. In each case the application of calculus to the problem is treated under a separate head, simpler mathematics being used in the general explanation of the subject. The treatment of the subject is straightforward and clear, and especially suited to classroom work.

REPORT ON THE EAST RIVER TUNNEL.—A General Report upon the Initiation and Construction of the Tunnel under the East River, New York, to the President and Directors of the East River Gas Co. By Charles M. Jacobs, Chief Engineer, Corbin Building, New York city. Cloth; 8vo; pp. 35; illustrated.

This report describes the preliminary work and surveys, as well as the details of construction of this tunnel, which has already been made familiar to our readers by a paper in our issue of March 1, 1894. The geological character of the ground met with is described in detail. The report states that the 36-in. gas main is now in place, and a railway track of 3-ft.

gage has been laid alongside it. The illustrations include half-tone views from photographs taken in the tunnel, plans and sections of the work, and drawings of the cast iron lining. It is to be regretted that the official reports of the engineers in charge of important works are not more often published in permanent form.

NINETEENTH ANNUAL REPORT OF THE CHIEF INSPECTOR OF MINES TO THE GOVERNOR OF THE STATE OF OHIO. For the year 1893.—By Robert M. Haseltine, Chief Inspector of Mines. Columbus, O. 8vo; paper; pp. 335.

The report states that owing to commercial depression the returns on capital invested in the mining industries have not been satisfactory. The coal output was 14,828,097 tons, of which 12,275,023 tons were produced by pick work, and 2,553,074 tons by mining machines. The coal shipped to lake ports amounted to 7,773,588 tons. The production of iron ore was 68,220 tons; of fire clay, 1,032,318 tons, and of limestone, 396,690 tons. The mining industries gave employment to 28,810 persons. There are notes on ventilation, explosive gas, powder, illuminating oils, etc., in mines, and 181 pages are devoted to notes on mines visited by the inspectors. The mining laws are also given. Of 327 accidents, 34 were fatal.

TRANSACTIONS OF THE ASSOCIATION OF ENGINEERS OF CORNELL UNIVERSITY, 1894. Secretary, C. H. Kendell, Ithaca, N. Y. Paper; 8vo; pp. 140; illustrated; $1.

This volume contains a lecture by Mr. Clemens Herschel on "Frontinus and his Books on the Water Supply of the City of Rome, A. D. 97," and also a paper entitled "Notes on Certain Field Methods Used on the Survey of the Mexican Boundary in 1892-93," by Mr. John F. Hayford; and "Some Notes on Fire Protection Engineering," by Mr. John R. Freeman. The latter is a very complete paper, occupying 56 pages.

U. S. GEOLOGICAL SURVEY. Thirteenth Annual Report to the Secretary of the Interior, 1891-92. By J. W. Powell, Director. Part I. Report of the Director, fol., 240 pp. Part II. Geology, fol., 372 pp. Many colored illustrations and maps. Washington, D. C., Government Printing Office.

TRADE PUBLICATIONS.

HEAT INSULATION AND FIRE PROTECTION.—H. W. Johns Mfg. Co., New York, N. Y. 12mo; pp. 24; illustrated.

This little pamphlet consists mainly of views of a large number of prominent buildings in which the company's asbestos coverings and other non-conducting materials are used, and including some of the U. S. cruisers and several power plants.

PASSENGER CARS. Jackson & Sharp Co., Wilmington, Del. Cloth; 4to; pp. 35; illustrated.

This is a very handsome volume containing 41 illustrations of day, parlor, sleeping, private and other cars, with a brief description of the works. Among the special cars shown may be noted the Allen hotel car, and a car of the electric elevated railway of the Columbian Exposition. The illustrations are excellent half-tone engravings.

ELECTRIC RAILWAY EQUIPMENT. Electrical & Mechanical Engineering & Trading Co., New York. Oblong 8vo; pp. 15; illustrated.

One of the specialties of this firm is a motor-driven, direct-connected generator styled a booster, the motor deriving its energy direct from the bus bars, and this arrangement gives a practically uniform voltage at the service end of the feeder under all conditions of load. Other specialties are the Vail rail bond and the Vail system of track feeding.

VALVES, LUBRICATORS AND STEAM SPECIALTIES. The Lunkenheimer Co., Cincinnati, O. 8vo; paper; pp. 107; illustrated.

This is a complete catalogue and price list of the company's manufactures in valves, safety valves, steam whistles, cocks, gages and lubricators of various kinds. It is stated that all steam goods are made according to the U. S. government standard for composition metal. Besides the regular lines of goods the company manufactures a large number of specialties.

THERMOMETERS AND GAGES. Hohmann & Maurer Mfg. Co., Brooklyn, N. Y. Paper; 8vo; pp. 12; illustrated.

This is the second part of the company's general catalogue, and includes the thermometers, gages and thermo-steam gages made for use in steam and hot water heating, baths, etc. The thermo-steam gage is a thermometer and steam gage combined and is intended for low pressure heating. The pamphlet contains notes on the proper setting of thermometers on heating apparatus.

HOISTER AND CONVEYOR.—Moore Mfg. Co., Buffalo, N. Y. Paper; 8vo; pp. 40; illustrated.

The Moore hoisting and conveying apparatus for use in excavating and backfilling sewer trenches, etc., consists of a steel trestle 288 ft. long, running on wheels on a portable track and having an upper track on which the conveyor car runs, this car being hauled by cable from an engine in a portable power house at the head of the trestle. Men on this car control the hoisting, conveying and lowering of the buckets. The illustrations are good half-tone engravings of these machines at work on different contracts.

CARSON TRENCH MACHINE. Carson Trench Machine Co., Charlestown, Boston, Mass. 8vo; paper; pp. 37; illustrated.

This is a new and revised edition of the company's catalogue of its machines for excavating and refilling all kinds of trenches, and special attention is called to the fact that the machines which have for ten years been rented exclusively are now either rented or sold outright. The pamphlet is handsomely got up, well printed and profusely illustrated by half-tone process cuts of machines in use in various cities. A full description is given, with details of capacity and cost of operation, etc.

COAL HANDLING IN POWER STATIONS.—C. W. Hunt Co., New York. 8vo; pp. 48; illustrated.

This is primarily a fully and handsomely illustrated description of the conveyor plant manufactured by this company. Sections and views are given showing these conveyor plants as installed in the Edison power stations of Boston and Brooklyn; at the Ridgewood pumping station of the Brooklyn Water-Works; the Brooklyn Heights Railroad Co.'s power house, and at other points. One very interesting section shows in detail the coaling station of the Philadelphia & Reading R. R. Co. in Philadelphia, illustrating the transfer of coal directly from the coal-cars to the tender of the locomotive, and also the manner of disposing of ashes.

ELECTRIC CARS AND TRUCKS. J. G. Brill Company, Philadelphia, Pa. Oblong; 4to; cloth; pp. 115; illustrated.

This is a handsome illustrated catalogue showing every variety of electric car for street and suburban railway service, including a number of double-deck cars, and a grimly gay funeral car. Among the interesting specialties are baggage, express, mail and freight cars, and a street-sprinkling car. Several of the company's special forms of street-car trucks are shown, among which we notice the Eureka truck for eight-wheel cars, having one pair of large motor-driven wheels and one pair of small wheels. There are also shown a convertible summer and winter car of the 125th St. cable road, New York, and a double-compartment car with vestibule and entrance at the middle of one side. The various styles of cars shown in this catalogue indicate the great progress which street railways have made since the days (not long ago) when the ordinary horse-car represented the highest development of the art.

SOCIETY PROCEEDINGS.

TECHNICAL SOCIETY OF THE PACIFIC COAST.—At the meeting on Nov. 2, in the rooms of the society, Academy of Sciences Building, San Francisco, Cal., there was a discussion on "The Relation of Railway Transportation to Production in California," papers upon which have been recently read before the society by Messrs. R. L. Dunn and W. G. Curtis. Mr. Curtis also presented a paper on "Timber Preserving Methods and Appliances." Otto von Geldern, Secy.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The nominating committee has reported the following list of names, which are now being voted on by letter ballot: President, E. F. C. Davis, Supt. Richmond Locomotive & Machine Works, Richmond, Va.; Vice-Presidents, F. H. Ball, New York city; Jesse M. Smith, Detroit, Mich.; M. L. Holman, St. Louis, Mo. Managers, John C. Kafer, New York city; Chas. A. Bauer, Springfield, O., and Arthur C. Walworth, Boston, Mass.; Treasurer, Wm. H. Wiley, New York city.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on Nov. 7 a paper by Mr. J. A. L. Waddell on "The Halsted St. Lift Bridge, Chicago," was presented. The bridge was described and illustrated in our issue of April 19, 1894. On Nov. 21 Mr. Cope Whitehouse will give a lecture on "The Proposed Reservoirs for the Storage of the Surplus Flood-Waters of the Nile and the Raiyan Drainage Canal." It will be illustrated by lantern slides showing the plans submitted to a technical commission, composed of Sir Benjamin Baker, Mr. Boule and Mr. Torricelli.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—At the October meeting of this association the papers prepared to be read before the "Good Roads Convention" meeting in Richmond, Oct. 18, by Mr. C. C. Wentworth on "Country Road Bridges" and by Mr. Clarence Coleman on "What Bad Roads Cost," were read and discussed. The regular fall meeting of the association will be held at Roanoke on Saturday, Nov. 17, at 4 p. m. A paper is expected from Mr. J. E. M. Hanckel on the Improvement of Roads in Knox county, Tenn., and Fulton County, Ga., and from Mr. H. A. Gillis, entitled, "Notes on Steel." Jno. A. Pilcher, Secy., Roanoke, Va.

LIVERPOOL ENGINEERING SOCIETY.—At the session on Oct. 24, the President, Prof. H. S. Hele-Shaw, M. Inst. C. E., delivered the inaugural address, taking as his subject "Locomotion in Air." In considering aerial navigation there are two problems corresponding to ordinary navigation: 1, to float in a fluid; and, 2, to devise methods for propulsion through a fluid. The difference between these two things was first compared, and the greater difficulty of aerial navigation considered. The subject was treated under the heads of artificial flight, and the invention and navigation of balloons. Under the first head the history was given of the various attempts at flight, which were classified accordingly as wings alone or wings with extended surfaces, or screw propellers were employed. Accounts were given of the more important devices in each of these cases, together with the actual results achieved. From this history it is evident that a large number of descents from considerable elevations were made at different times and with different appliances, in some cases successfully and in other cases with only a broken limb, although, as is well known, fatal results have often occurred. The scientific details of Mr. Maxim's machine, as well as of several others, were carefully considered.

Coming next to the subject of the invention and navigation of balloons, an account of the various attempts which have been made was given, and a particular description of the more recent balloons which have been made in the shape of a torpedo, and have been propelled either by steam power, manual power or electricity, was given. Messrs. Giffard, Dupuy de Lome, Gaston Tissandier and others, have achieved wonderful results with such balloons. Finally, a comparison was given of the relative advantages of flying machines and navigable balloons, the opinion being expressed that whereas navigable balloons had achieved a great and undoubted success, and probably would play an important part in future wars, that it could scarcely be expected that such contrivances would come into actual and general use for commercial purposes, although there was no reason for thinking that wealthy individuals would not have such appliances at little, if any, more expense than their private yachts. Such navigable balloons could, when the wind was too strong, be kept safely in a suitable shed. With regard to flying machines, the case was different; scientific men have never regarded the ultimate successful construction of the flying machine as an impossibility, and there is nothing whatever mechanically absurd in the idea. That there were great and undoubted difficulties which would always remain could not be denied, but probably at the present day the idea is not more extravagant than that of the iron ship and iron horse of 150 years ago.

COMING TECHNICAL MEETINGS.

FRANKLIN INSTITUTE, PHILADELPHIA.
Nov. 9. "The Coal Mine," by H. M. Chance. Secy., W. H. Wahl.

MONTANA SOCIETY OF CIVIL ENGINEERS.
Nov. 10. Secy., G. O. Foss, Helena, Mont.

ENGINEERS' CLUB OF INDIANAPOLIS.
Nov. 10. Secy., C. C. Brown.

WISCONSIN POLYTECHNIC SOCIETY.
Nov. 12. Secy., Geo. G. Mason, 144 8th St., Milwaukee.

ENGINEERS' CLUB OF KANSAS CITY.
Nov. 12. Secy., F. W. Tuttle, Baird Building.

NORTHWESTERN RAILWAY CLUB.
Nov. 13. Secy., W. D. Crosman, Ryan Hotel, St. Paul.

NORTHWESTERN SOCIETY OF ENGINEERS.
Nov. 13. Secy., D. W. McMorris, Burke Building, Seattle, Wash.

CIVIL ENGINEERS CLUB OF CLEVELAND.
Nov. 13. Secy., F. C. Osborn, 721 Hickox Building.

DENVER SOCIETY OF CIVIL ENGINEERS.
Nov. 13. Secy., F. Ed. King, 36 Jacobson Block.

NEW ENGLAND RAILROAD CLUB.
Nov. 14. Secy., F. M. Curtis, P. O. Box 1576, Boston, Mass.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
Nov. 15. Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.

SOCIETY NAVAL ARCHITECTS & MARINE ENGINEERS.
Nov. 15 and 16. Annual Convention in New York city. Secy., W. L. Capps, U. S. N., Washington, D. C.

ENGINEERS' CLUB OF CINCINNATI.
Nov. 15. Secy., J. F. Wilson, 24 W. 4th St.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
Nov. 15. Secy., D. Carhart, Carnegie Library Building, Allegheny.

NEW YORK RAILROAD CLUB.
Nov. 15. Secy., John A. Hill, Temple Court, N. Y. City.

ENGINEERS' CLUB OF PHILADELPHIA.
Nov. 17. Secy., L. F. Rondinella, 1122 Girard St.

ENGINEERS' CLUB OF MINNEAPOLIS.
Nov. 19. Secy., E. Nexsen, Kasota Block.

WESTERN RAILWAY CLUB.
Nov. 20. Secy., W. D. Crosman, Rookery Building.

COLUMBIAN ENGINEERING SOCIETY.
Nov. 20. Secy., F. W. Hart, Washington, D. C.

ASSOCIATION OF ENGINEERS OF VIRGINIA.
Nov. 21. Secy., J. H. Pilcher, Roanoke, Va.

BOSTON SOCIETY OF CIVIL ENGINEERS.
Nov. 21. Secy., S. E. Tinkham, 36 Bromfield St.

ENGINEERS' CLUB OF ST. LOUIS.
Nov. 21. Report on "Smoke Prevention." Secy., W. H. Bryan, Turner Block.

AMERICAN SOCIETY OF CIVIL ENGINEERS.
Nov. 21. "The Halsted St. Lift Bridge." J. A. L. Waddell. Secy., Francis Collingwood, 127 E. 23d St., N. Y.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Nov. 22. Secy., C. H. McLeod, 112 Mansfield St., Montreal.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
Dec. 3 to 7. Secy., F. R. Hutton, 12 W. 31st St., New York.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Dec. 3. Secy., C. L. Annan, City Engineer's Office.

WESTERN SOCIETY OF ENGINEERS.
Dec. 5. Secy., Thomas Appleton, Lakeside Bldg., Chicago.

TECHNICAL SOCIETY OF THE PACIFIC COAST.
Dec. 7. Secy., O. Von Geldern, 719 Market St., San Francisco.

ENGINEERING ASSOCIATION OF THE SOUTH.
Dec. 13. Secy., Hunter McDonald, Nashville, Tenn.

ENGINEERS & ARCHITECTS' CLUB OF LOUISVILLE.
Dec. 13. Secy., G. W. Shaw, Norton Building.

NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
Dec. 14. Secy., D. W. Meeker, St. Paul, Minn.

CENTRAL RAILWAY CLUB.
Jan. 13. Secy., S. W. Spear, East Buffalo Iron Works, Buffalo, N. Y.

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AND

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The vote in New York city at the election this week was in favor of the construction by the city of a rapid transit railway according to the plans legalized at the last session of the legislature. In all probability this vote finally settles the rapid transit question in New York city, after nearly ten years of agitation.

Some peculiar cases of corrosion of copper piping have occurred in the U. S. Navy, and are referred to by Chief Engineer Melville in his report just issued. The copper pipes attacked are found invariably to be either conveying or surrounded by salt water, and it is also said that all cases thus far noted have been in steel ships fitted with dynamos for electric lighting. The theory has been put forth that the corrosion is due to the action of electric currents. The copper of which the pipes are made is known to be of the best quality, and not affected by salt water under ordinary conditions. Further, precisely similar pipes on iron vessels like the "Alert" and "Ranger," which have no dynamos, last almost indefinitely. On the other hand, it is difficult to explain how the electric current from the lighting circuits could reach these copper pipes. The Bureau of Steam Engineering is taking steps to ascertain the exact cause of the difficulty, and the results of its work will be awaited with interest.

The author of an article upon "The Present Condition of the Panama Canal," published in the September issue of the "Engineering Magazine," says that the company has on hand an immense stock of machinery, tools, dredges, etc., "kept in such a condition, as far as I could ascertain, that renewed construction could be taken up and carried to a finish at any time."

We fear that the personal inspection made by the writer of the above was not a very searching one, as far as the condition of this plant was concerned. A trip over the line of the canal, made about two years ago by one of the editors of this journal, showed quite a different state of affairs, both as to plant and the condition of the work once performed by the contractors. That trip was made just after an official visit by a committee of the Canal Company; and while the machinery was beautifully painted and all bright parts were carefully whiteleaded, a closer inspection, made with a view of possible purchase of some of this plant, showed that fire-doors were often mere masses of rust, and that a vigorous kick would burst a hole in the boilers of a goodly number of the machines. Furthermore, under the system of percentages paid to the purchasers of plant for the company, many of the rock-drills, dredges, etc., were utterly unfitted for the work to be performed at Panama, and have never been in service at all. Belgian dredges were seen lying in what was once a waterway, now converted into dry land by the silt brought down in Chagres floods, and the dredges were almost hidden from view by tropical growth. On the Atlantic side of the Culebra cut a great part of the channel, dredged out at an immense cost by the American Dredging Co., has been so filled up by deposits from the Chagres that a canoe can scarcely navigate at places where there was once a 20-ft. channel. In fact, on that inspection the bulk of the plant on the line of the canal seemed worthless as an asset, and any company honestly intent upon the completion of this abandoned enterprise would find it much more economical to provide an entirely new and more efficient equipment. Of course the docks and shops at Colon, the hospital at Panama and the buildings erected in wasteful profusion between these points, could be utilized; but we would advise any new promoters of a Panama Canal to provide liberally for renewing the excavating plant. With even the most faithful care, six or seven years' exposure of iron and steel to the influence of a Panama climate is not conducive to its good working condition. From all that can be learned from the Paris press, the present effort to re-arouse public interest in this Canal is little more than a great "bluff," based upon totally insufficient means and no well formulated plans of action. The methods of the present promoters, taken in connection with the proved rascality of their predecessors in the directory, are not calculated to lead the much-defrauded Frenchmen into further investments in a sea-level, or any other canal at Panama. The present capital of the new promoters seems to consist entirely of blood-money extorted from contractors under the old corrupt regime, and the aggregate represents but the merest fraction of the probable ultimate cost of any kind of a ship-canal across the Panama isthmus.

An epidemic of typhoid fever is in progress at Winnipeg, Man., which seems to be largely due to the use of water from wells. During the month of September and the first 23 or 24 days of October 154 cases were reported, and Health Officer Ingles believes that these do not include more than two-thirds of the total. A study of 132 cases shows them to be fairly well divided among the various milk dealers, so that this is not suspected, as a source of infection, but in 29 cases the patients are known to have used water from two public wells, 19 from one and 10 from another. Most of the cases are in houses connected with the sewers, which might indicate that many of them had used water from wells polluted by cesspools or privies. Some of the citizens have become impressed with the idea that sewer gas is the cause of the disease, and they have so far influenced the health officer as to cause him to recommend that biological examinations be made of air from sewers in various parts of the city, as well as similar studies of suspected well water.

Strenuous efforts might well be made to discover and close polluted wells, and to ascertain whether the public water supply is satisfactory, and after this has been done, biological examinations of sewer air could of course do no harm. Judging from the most recent investigations along this line, however, hunting for typhoid germs in sewer air is pretty certain to be fruitless. As a matter of fact, most of the typhoid cases in Winnipeg are said to be in houses not connected with sewers, which ought in itself to put a quietus on the sewer-gas theory. The vital statistics of Winnipeg are alleged by Dr. Ingles to be so inadequate that he cannot tell whether the present large number of cases of typhoid is unusual as compared with previous years, a condition which, if true, is shameful for a city the size of Winnipeg, or indeed for the smallest town in a civilized country.

CO-OPERATION AMONG ENGINEERING SOCIETIES.

Among the bound volumes of the proceedings of engineering societies upon our shelves we know of none which contain in a smaller space a greater amount of valuable matter than the dozen volumes thus far issued of the "Journal of the Association of Engineering Societies." As many of our readers know, this associaton was formed in 1881 "to secure joint publication of the papers and transactions of the participating societies." Through this joint publication a large number of valuable technical papers have been preserved in a form in which they are permanently available for reference.

The work of the Association has been brought into some prominence of late, first by the withdrawal of the Western Society of Engineers, and second by the announcement of a movement toward an enlargement of the field of the society by adding largely to its membership. Four societies, those of St. Louis, Cleveland, Boston and Chicago, organized the Society, and four other societies—Kansas City, St. Paul, Minneapolis and Montana—have joined since organization. There are at least a dozen local engineering societies so constituted as to be eligible to membership in the Association; and if it is a fact that the past years of co-operation have been of value to the societies within the Association, it would seem highly probable that those still outside of the Association would find it to their advantage to join it.

The local engineering societies of the country effect two important purposes. First and chiefly, they foster a more intimate acquaintance among those engaged in engineering pursuits, and this acquaintance is not only pleasant but profitable in the opportunity it affords for the exchange of information, the comparison of experience and that professional "small talk" which, apart from its actual value as information, serves to stimulate and broaden a man's mind.

Second, the society as an organization affords an opportunity at its stated meetings for the formal presentation and discussion of records of professional experience; but few engineers will take the trouble to prepare a formal paper in a thorough and complete manner for the sake of the dozen or score of members, which may be taken as about the average attendance at the stated meetings of a local engineering society. Every such society, therefore, aims to secure the publication of its papers; and while it does this primarily for its own benefit and the benefit of its members, such publication may be of importance to the profession at large by securing the permanent record in a form available for reference of the papers of technical value.

It will add to clearness in discussing the status of these local engineering societies if these two chief purposes of their existence are kept distinct. The first, affording facilities for mutual acquaintance, is a work which each society must do for itself. Co-operation with other societies can help or hinder in this work only in so far as such co-operation may give added prestige, and thus help to increase the roll of membership. This is a fact which is too often lost sight of. It is a mistake to suppose that the local clubs are real rivals of the national engineering societies, or that we may expect to see any national society, whatever its character, absorb the separate local societies and obliterate their individuality. An excellent illustration of the fact that the national engineering societies do not fill the want which is met by the local clubs is furnished by the fact that the most prosperous engineers' club in the country is in New York city, where the headquarters of all the national engineering societies are located.

It is, however, the work of the local societies as "manufacturers of engineering literature" that we wish especially to discuss. With respect to this a society has three courses open to it. (1) It can keep out of the printing business altogether, and permit the papers and discussions before it to go into oblivion. The natural result of this will be that few papers of much value will be prepared for the meeting. A man who has something to say of general importance and value to the profession will prefer to say it where it will command a wider audience and will be preserved in permanent form.

(2) The society can assume the burden of printing its own proceedings, and this is now done by a num-

ber of societies. We have before us a copy of one such publication. Its printed page measures 4 × 6½ ins. and there are 13 pages in the pamphlet, which is printed in a very coarse type. Altogether there is about as much printed matter as would cover about four columns of Engineering News. From the printed announcement on the cover of this pamphlet we learn that the price of this publication is 75 cts. per number, or $7 per year (ten numbers). From a somewhat intimate and extended acquaintance with the course of prices, supply and demand in engineering literature, we feel safe in saying that the engineer who will pay so much money for such small value in the shape of professional literature is a rare bird. Manifestly, the circulation of such a periodical must be practically confined to the membership of the society, that is to say, to a couple of hundred engineers more or less, representing all grades and branches of the profession; any given paper, therefore, is apt to interest only a few out of this small number. A high price for subscriptions, however, does not necessarily mean ample income from publication. We notice that the managers of the society above referred to expressly warn all contributors to use as few illustrations as possible and limit closely their size. They also eke out their income by inserting advertisements; but it is plain that advertising in periodicals of such limited circulation is done for other reasons than the hope of profit from the advertisements themselves.

So much for the actual state of affairs in one society. Another which we call to mind publishes its "proceedings" at a moderate price; but its expenses have been so heavy for a number of years as to cause considerable complaint and dissension among the members.

(3) Any society can become a member of the Association, in which case the valuable papers read before it will be published in the Association journal, and will thus be brought before a wide circle of readers and preserved in permanent form. The Association is not an experiment, but has been a successful organization for over a dozen years, and, as we have said above, has done a work of great usefulness and value to the profession.

It must, of course, be freely admitted that there are some difficulties in the successful conduct of the Association journal. To publish all the papers read before all the societies would result in the inclusion of a large amount of comparatively trivial matter. But in deciding what shall and what shall not be published in the journal some one's feelings are occasionally injured, and out of these trivial causes jealousies and dissensions of considerable magnitude may grow. At the same time good management has thus far piloted the Association with fair success; and it may probably be trusted to guide it in the new departure on which it is entering. A circular letter has just been sent to the local societies which are still outside the Association proposing an enlargement of the Association. It is explained that such membership need not interfere with the separate publication of papers when a society so desires, as after the papers have been printed for the "Journal" any desired number of reprints can be made from the same type and these can be furnished to the local societiy for issue as its own transactions. In that way the local society can still issue its separate transactions and retain whatever income it gains from advertising. Advance copies of papers can also be furnished when desired.

At present the tax on each member of societies in the Association due to the issue of the "Journal" is about $3 per annum, for which each member receives a subscription to the "Journal," including the valuable index to technical literature, a very fair return for the money. If the number of societies in the Association were to be doubled, however, it is entirely reasonable to expect that the amount of matter in the "Journal" could be largely increased, and its circulation would extend in even greater proportion.

Upon this last feature much emphasis needs to be laid. A man does not write a paper to be read before a technical society with the intention of hiding his light under a bushel. The wider publicity his paper receives, the greater will be the benefit to him in professional reputation. The publications of the local societies are in many cases issued at irregular intervals and in various forms. They are received by few engineering libraries and preserved and bound for reference by fewer. The "Journal" of the associated societies, on the other hand, has already a wide circulation, and if it were enlarged and improved by the contributions of the other local societies now independent, this circulation would be largely increased.

A word, too, may fitly be said here with respect to the interest of the profession at large in having such co-operation brought about. It is everywhere conceded that the multiplication of engineering literature is to be deplored. There is a deal too much trivial and "popular" engineering literature. There is never enough of accurate records of actual works, experimental researches and similar matter. It is heaping grievous burdens on the profession for every local engineering society to attempt to widely circulate its thin monthly pamphlets, but it will be a real boon to engineers if the cream of the papers read before a score of these local societies are collected and published in permanent form. For all these reasons it is greatly to be hoped that the movement for an extension of the field covered by the Association will be successful.

LETTERS TO THE EDITOR.

USE THE BRIGHT SIDE OF TRACING LINEN.

Sir: Enclosed please find two blackprints. Print A was taken with the dull side of the tracing cloth towards the sun. Fig. 1 was traced on the dull side of the cloth. Of Fig. 2, the part on the left of the line m n was made on the dull side of the cloth; the part on the right of m n was made on the bright side of the cloth. Fig. 3 was made on the bright side of the cloth. The same pens were used throughout for the same part of the sketch, so as to have the lines of the same breadth. It will be noticed that the part traced on the bright side of the cloth gives the more distinct prints.

Print B was taken with the bright side of the cloth towards the sun, Figs. 4, 5 and 6 being 1, 2 and 3, respectively, of print A. It will still be noticed that the lines on the bright side of the cloth give the more distinct prints. This difference is more pronounced on blueprints. The conclusion reached is that for a distinct print lines should be traced on the bright side of the cloth, and that side should be used in printing.

Yours truly, Wm. Grant Miller,
Civil Engineer.

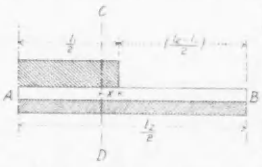
Chambersburg, Pa., Nov. 1, 1894.

(We do not reproduce the prints sent, as they merely corroborate our correspondent's statements. Probably the only reason why any one ever thinks of drawing on the dull side of tracing linen is that the bright side sometimes does not take the ink readily. Doubtless most of our readers know, however, that a minute's rubbing with powdered pumice stone when the cloth is first laid on the board will entirely remove this difficulty. Except where it is desired to work with a pencil, the bright side of the cloth should always be used.—Ed.)

COMPUTING THE STRENGTH OF CONCRETE AND STEEL FOUNDATIONS.

Sir: I write this to call attention to what I believe to be a somewhat general oversight in the designing of steel foundations. The problem, as it usually appears, is this: Given a load uniformly distributed over a certain length of the top of a beam, what is the safe projection of the beam beyond this distributed load, assuming that the beam distributes the same total load uniformly over its bottom surface?

In the following analysis the weight of the beam itself is neglected. Let the intensity of the load over a length, l_1, of the top of the beam be w_1, and that over the entire length, l_2, of the bottom be w_2, then in order for the loads to be the same and neglecting the weight of the beam itself, we must have $l_1 w_1 = l_2 w_2$.



Let A B represent one-half of the beam, the shaded portions representing the loads, the top load acting downward and the bottom upward. Let M be the bending moment on the beam at the section C D distant x from the end of the top uniform load toward the center of the beam; then,

$$M x = \frac{w_2}{2}\left(\frac{l_2 - l_1}{2} + x\right)^2 - \frac{w_1 x^2}{2} \qquad (1)$$

This is a maximum when $x = \frac{w_2 (l_2 - l_1)}{2 (w_1 - w_2)}$, and substituting this value of x in Eq. (1), we have, after a little reduction:

$$\text{Max. } M = \frac{w_2 (l_2 - l_1)^2}{8} \cdot \frac{w_1}{w_1 - w_2} = \frac{w_2 (l_2 - l_1)^2}{8} \cdot \frac{l_2}{l_2 - l_1} \qquad (2)$$

(since $w_1 l_1 = w_2 l_2$) or $\text{max. } M = \frac{w_2 l_2 (l_2 - l_1)}{8}$. (3)

Let n be the number of beams and L the total load on the foundation, then neglecting the weight of the beams, $n w_2 l_2 = L$, and substituting $\frac{L}{n}$ for $w_2 l_2$ in Eq. (3), we have:

$$\text{max. } M = \frac{L (l_2 - l_1)}{8 n}. \qquad (4)$$

If in Eq. (1) we let $x = 0$ we have $M_0 = \frac{w_2 (l_2 - l_1)^2}{8}$; hence, by Eq. (2),

$$\text{max. } M = \frac{l_2}{l_2 - l_1} M_0. \qquad (5)$$

It has been usual to use M_0 for determining the safe projection; the difference between using the max. M and M_0 can best be shown by taking as an example a column, the data for which were given in an article printed in Engineering News some years ago (Aug. 8, 1891). In this case the top course consists of nine 15-in. I-beams, 50 lbs. per ft., the bearing plate of the column being 5 ft. square; the length of the beams is 15 ft. 8 ins. $= l_2$; $l_1 = 5$ ft. The length of the projection was determined from M_0 and an extreme fiber strain of 20,000 lbs. per sq. in. was used. If the fiber strain at the section where the bending moment is M_0 is 20,000 lbs., at the section where the bending moment is a maximum the fiber strain is $20{,}000 \times \frac{l_2}{l_2 - l_1}$ (by Eq. (5)),

or $20{,}000 \times \frac{15 \text{ ft. } 8 \text{ ins.}}{10 \text{ ft. } 8 \text{ ins.}} = 29{,}375$ lbs. per sq. in.

The second course consists of 31 steel rails 9 ft. 10 ins. long; the third course is of 19 rails 21 ft. 4 ins. long; and the bottom course is of 30 rails 15 ft. 11 ins. long. These rails weigh 75 lbs. per yd. and measure 4¾ ins. in height and width of base. An extreme fiber strain of 16,000 lbs. per sq. in. was used. If these rails have an extreme fiber strain of 16,000 lbs. where the moment was taken, they have an extreme fiber strain in the three courses of 32,200 lbs. per sq. in., 60,000 lbs. per sq. in. and 41,900 lbs. per sq. in., respectively, where the moment is a maximum. These fiber strains were found by multiplying 16,000 lbs. per sq. in. by the ratio $\frac{l_2}{l_2 - l_1}$ in each case. The second course from the bottom seems to be subjected to a stress dangerously near its tensile strength. The load on the column is 1,166,000 lbs. and the quantities given in the article referred to are taken as correct. The concrete filling between and around the beams was neglected as usual in such cases. A similar oversight is usually made in the designing of masonry and concrete foundations, but it is not necessary to consider this case in detail here.

Yours truly, W. H. Schuerman.

Eng. Dept., Vanderbilt University, Nashville, Tenn., Oct. 17, 1894.

(Similar criticisms to that of our correspondent were made in a discussion in these columns three years ago, which many of our readers will doubtless remember. The issues containing the discussion were Aug. 8, Sept. 19, Oct. 3 and Oct. 31, 1891. The facts briefly stated are that in computing the strength of the foundation, the concrete filling around the beam was neglected, and the steel was given a unit stress considerably above its elastic limit, and the concrete was relied on to give sufficient additional strength to ensure safety. As a matter of fact the whole foundation is really one solid mass, and takes strains as one mass, and not as a series of independent courses, as the hypothesis supposes. Being a solid mass, it really acts as a built-up beam, in which the concrete takes compression and the steel takes tension. Experience with the Monier and Melan systems of concrete steel construction have shown such perfect adhesion between the steel and the concrete that it is a question worth considering whether a better knowledge of the real strength of a steel and concrete foundation would be gained if the foundation were computed on some assumption which would conform more nearly to its real action. Of course it is admitted that nothing like exact figures are available for computing the strength of a composite mass of concrete and iron, while the strains which the beams will stand if the concrete were absent can be very closely calculated. The real question is, which method of computation will give the best idea of the actual strength? and on this question there appears to be plenty of room for honest difference of opinion.—Ed.)

THE MUSSY VIADUCT, FRANCE.

The Paris, Lyons & Mediterranean railway company is now building across the valley of the Mussy what will be one of the most important masonry viaducts in France. Our contemporary "Le Genie Civil" gives its principal dimensions as follows:

Total length of viaduct	1,840 ft.
Height 5 central piers; ground to rail level	196.8 ft.
Number of arches	18
Span of arches	82 ft.
Section of abutments at springing line	32.8 × 26.6 ft.
Section of 14 piers at springing line	16.4 × 34.7 "
Section of three abutment piers	23 × 34.7 "
Batter on long face of piers	1 to 40
Batter on short face of piers	1 to 20
Total volume of masonry	97,500 cu.yds.
Total surface of face work, about	45,500 sq.yds.

The foundations vary from 26 to 58 ft. in depth, and these were built in pits lined with timber and strongly braced. The stone used is a granite obtained from quarries about 6 miles from the viaduct.

To construct the mass of pier masonry rising 150 ft. above the ground, five movable iron bridges are used, provided with jack screws at both ends, so that they may be lifted as the piers increase in height. These bridges are 88.6 ft. long and are made of two riveted girders, 4.92 ft. deep, so arranged as to form protecting sides to the bridge. Four of these bridges are 9.9 ft. wide, and the fifth is 14.43 ft. wide, with two openings, 6.6 ft. square, near one of its ends. Above these traps is a framework of T-iron and angle iron supporting the hoisting apparatus. These bridges can be taken apart for facility in transport and lifting. Two 20-in. trackways lead from the traps across the bridge, and these are provided with turntables, crossings, etc. Automatic doors close the traps.

THE MUSSY VIADUCT, FRANCE.

The material is lifted to the bridges at a speed of 328 ft. per minute by a double-drum steam hoist of 25 HP., and the bridges are calculated to carry a center load of 13,200 lbs. To save the expense of too many bridges, one-half of the piers were built at one time.

To build the arches, a double track of 2.0-in. gage was located on a trestlework built above and resting on the arch centers, and the material was lowered down to position. An inclined plane about 1,250 ft. long fed the stone to the tracks above the arches, and the centers rested upon cut-stone projections built into the pier masonry. To facilitate the raising of the centers and to give the carpenters access to the several piers, these piers, from No. 5 to No. 15, were tied together at the height of the springing line by five steel wire cables, spaced 5.4 ft. apart, and fixed to solid irons built into the masonry. Each cable had at one end a turn-buckle to regulate its tension, and was tested under a strain of 4,400 lbs. Upon these cables was placed a platform 1½ ins. thick. The wooden centers were lifted by means of a 5-HP. engine and derricks placed upon the pier.

This viaduct was commenced in March, 1892, and work upon the masonry began in June following. The estimated cost of the whole viaduct is about $600,000. The view given is redrawn from an engraving published in "Le Genie Civil."

The transfer sheds of the St. Louis Terminal Co. at East St. Louis, Ill., were destroyed by fire on Oct. 27, together with 92 freight cars. These sheds were the largest of the kind in the country, being 700 ft. long and arranged to accommodate 150 cars. The estimated loss is $225,000. A carload of powder was in the sheds at the time, but it was hauled out by a daring crew and the flames, which had already appeared on the car, were extinguished.

A RATIONAL THEORY FOR THE STRAINS IN COLUMNS.

By Lieut. A. M. D'Armit, Corps of Engineers, U. S. A.

It would seem possible, in the following manner, to deduce a theory for the strains in columns of any length without reference to the crushing strength of the material and based solely on the accepted theory of elasticity.

Assume the following notation:

d = maximum ordinate at the center.
M = bending moment at the center.
P = maximum strain on the unit of cross section.
l = half length of the column.
I = least moment of inertia.
A = total area of cross section.
T = total applied force.

Consider the column as a beam resting on two points of support and free to move at both ends; this will correspond to the case of a column with both ends rounded.

Considered purely as a beam we have:

$$P = \frac{M\,d}{I} \qquad (1)$$

The applied force may be considered as divided into two components, one transverse to the column, producing the above strain and resisted by friction, and the other producing compression. Thus considered, their intensities are respectively $T \tan \phi$ and $\frac{T}{\cos \phi}$, ϕ being the angle made by the curve of mean fiber, when acted on at the center by $2\,T \tan \phi = 2\,W$.

Since the strain in (1) is either tension or compression, its dangerous limit will be compression or on the concave side, since $\frac{T}{\cos \phi}$ acts compressively. Therefore the total strain is:

$$P = \frac{M\,d}{I} + \frac{T}{A \cos \phi}$$

But

$$M = T\,l \tan \phi.$$

Hence

$$P = \frac{T \tan \phi\, l\, d}{I} + \frac{T}{A \cos \phi} \qquad (2)$$

This equation shows that a certain relation exists between P and T. Evidently there is no maximum value of P with respect to T, as its value steadily increases with ϕ. A minimum value results, however, when $\sin \phi = -\frac{I}{A\,l\,d}$. That is to say, when $\sin \phi$ has this negative value, the strain at the center is zero on the outside fiber.

The equation of the curve of mean fiber is as follows:

$$y = \frac{W}{6\,E\,I}(3\,l^2\,x - x^3)$$

Differentiating and making $x = 0$ we deduce

$$\tan \phi = \frac{W\,l^2}{2\,E\,I}$$

This is the value of the tangent of the angle in terms of the weight in the middle and the constants of the column. It shows that the tangent increases directly with the force acting perpendicularly to the column.

We now have two equations for determining P, W, and $\tan \phi$. To obtain a third we may put (2) into another form thus:

$$\frac{W\,l\,d}{I} = P - \frac{T}{A}$$

This will give an erroneous value, since we have assumed $\cos \phi = 1$, which, however, is not far from correct within the limits of practice. Moreover, the results will afford us a means of correcting the error. Solving the three equations, we obtain, after suitable transformations

$$\tan \phi = \frac{l\,P}{2\,E\,d} - \frac{d}{3\,l}$$

For $P = 0$ we have $\tan \phi = -\frac{d}{3\,l}$ which marks the error introduced, since for this condition $\tan \phi$ must equal zero. Hence our true value is

$$\tan \phi = \frac{l\,P}{2\,E\,d}$$

which form is entirely rational. Substituting in (2) we have

$$P = \frac{T\,l^2\,P}{2\,E\,I} + \frac{T\sqrt{4\,E^2\,d^2 + l^2\,P^2}}{2\,A\,E\,d}$$

Solving for P we obtain

$$P = \frac{2\,T\,E\,d\,l}{\sqrt{4\,A^2\,E\,d\,I\,(E\,I - T\,l^2) + T^2\,l^2\,(A^2\,l^2\,d^2 - I^2)}}$$

A much simpler formula for P will be found by making $\cos \phi = 1$, which gives, after reduction

$$P = \frac{2\,T\,E\,I}{A\,(2\,E\,I - T\,l^2)}$$

a formula almost the same as the one deduced by Professor Merriman and identical with it if we assume $\pi^2 = 8$. Since this value for π^2 enters both numerators and the controlling term of both denominators the results will not be far apart.

This formula, however, is not the best one that can be deduced, nor is it theoretically correct, although it gives results not far from the true values. Referring back to the value of $\tan \phi$ first deduced, we must remember that while $T = 0$ gives $P = 0$, we may have $P = 0$ when T is not zero, and this is the very case that arises in solving for $\tan \phi$. When $\sin \phi = -\frac{I}{A\,l\,d}$, the value of P is zero, as already shown. Substituting for I its value, $A\,r^2$, we obtain $\sin \phi = -\frac{d}{3\,l}$, and the difference between this value and $\tan \phi = -\frac{d}{3\,l}$ is the true error introduced in assuming $\cos \phi = 1$. Reducing the value of $\sin \phi$ we have finally

$$\tan \phi = \frac{l\,P}{2\,E\,d} - \frac{d}{\sqrt{9\,l^2 - d^2}}$$

which value is free from all errors of approximation.

The value of P now results from a simple substitution which gives, however, an exceedingly complicated result. Making $\cos \phi = 1$, we deduce

$$P = \frac{2\,E\,T\,(r^2\sqrt{9\,l^2 - d^2} - l\,d^2)}{(2\,E\,I - T\,l^2)\sqrt{9\,l^2 - d^2}}$$

For all practical purposes the following formula is sufficiently accurate:

$$P = \frac{2\,T\,E\,(3\,r^2 - d^2)}{6\,E\,I - 3\,T\,l^2}$$

This formula, deduced solely with reference to the elastic theory of strains, is presented for criticism and comparison with others. It is rational in its form, and for $l = 0$ the strain reduces to one of pure compression, as it should. A slight error is introduced by assuming the purely compressive force to be $\frac{T}{\cos \phi}$, but it is not believed that the discrepancy from the true expression is material.

Having now the strength of a column with both ends round, the strength of other forms is obtained by multiplying by 2 and by 3 for one end round and both ends flat respectively, as stated by Mr. Hodgkinson.

This rule, however, is based upon experiments made upon pillars tested to destruction. To determine a coefficient within the limit of elasticity, advantage may be taken of Professor Merriman's discussion and the close accordance of his formula with the purely theoretical one deduced above. In the nomenclature assumed in this discussion his formula is

$$P = \frac{T\,r^2\,\pi^2\,E}{\pi^2\,E\,I - 4\,T\,n\,l^2}$$

For any given case, P varies inversely as the de-

nominator. Making n = 1, we have the case for rounded ends. Making n = ¼, we have the case of both ends fixed. The reciprocal of the ratio is

$$K = \frac{4\,E\,I\,\pi^2 - 16\,T\,l^2}{4\,E\,I\,\pi^2 - 4\,T\,l^2}$$

Making $n = \frac{4}{9}$ we have

$$K^1 = \frac{9\,E\,I\,\pi^2 - 36\,T\,l^2}{9\,E\,I\,\pi^2 - 16\,T\,l^2}$$

K and K^1 are, therefore, coefficients by which P must be multiplied to reduce the pressure to the proper amount for the two cases respectively. They both reduce to unity for l = 0, as they should.

From the equation of the curve of mean fiber we deduce the maximum deflection to be

$$f = \tfrac{1}{3}\frac{W\,l^3}{E\,I}.$$

Dividing by the value of W we have

$$f = \tfrac{2}{3}\,l \tan \phi.$$

Substituting the value of the tangent already deduced we obtain

$$f = \frac{l^2\,P}{3\,E\,d} - \frac{2\,d}{9}$$

which expression gives us the amount of deflection from the vertical.

A DAY AND NIGHT TIME-TABLE SYSTEM.

An innovation in the printing of railway time tables has been recently brought out by the railway printing house of The Corbitt & Skidmore Co., 21 Plymouth Place, Chicago. The innovation consists in printing the figures denoting time between 6 p. m. and 6 a. m. in type which shows the figures in white on a black blackground, a distinction between hours of daylight and of darkness which the dullest cannot fail to comprehend.

We reproduce herewith the west-bound time table

NEW ORLEANS TO SAN FRANCISCO

MLS.	STATIONS	TIME	DAY	ALT.
0	*Leave* New Orleans	8.00	*Thursday*	....
144	*Arrive* La Fayette	12.30	"	51
144	*Leave* La Fayette	12.40	"	51
195	" Welsh	2.07	"	32
257	" Orange	3.47	"	21
278	" Beaumont	4.20	"	32
298	" Sour Lake	4.48	"	54
362	*Arrive* Houston (H & T C)	6.30	"	64
362	*Leave* Houston (H & T C)	6.50	"	64
450	" Glidden	9.15	"	242
470	" Schulenburg	9.48	"	352
516	" Luling	.....	"	416
537	" Seguin	11.44	"	599
571	*Arrive* San Antonio	12.40	*Friday*	686
571	*Leave* San Antonio	1.00	"	686
642	" Sabinal	.....	"	963
665	" Uvalde	3.39	"	930
705	" Spofford	.....	"	1015
741	*Arrive* Del Rio	5.45	"	955
741	*Leave* Del Rio	5.55	"	955
806	" Langtry	7.54	"	1321
879	*Arrive* Sanderson	10.30	"	2780
879	*Leave* Sanderson	10.40	"	2780
971	" Alpine	1.32	"	4485
1034	*Arrive* Valentine	3.20	"	4424
1034	*Leave* Valentine	3.25	"	4424
1194	*Arrive* El Paso	7.50	"	3713
1194	*Leave* El Paso	6.10	"	3713
1282	" Deming	8.50	"	4334
1458	" Benson	1.45	*Saturday*	3578
1507	*Arrive* Tucson	3.15	"	2390
1507	*Leave* Tucson	3.30	"	2390
1593	" Maricopa	5.50	"	1173
1758	*Arrive* Yuma	10.35	"	140
1858	*Leave* Yuma	10.40	"	140
1877	" Indio	1.45	"	20
1949	" Colton	4.35	"	965
2006	*Arrive* Los Angeles	6.40	"	293
2006	*Leave* Los Angeles	6.40	"	293
2037	" Saugus	8.05	"	1159
2100	" Mojave	10.55	"	2751
2174	*Arrive* Bakersfield	2.10	*Sunday*	415
2174	*Leave* Bakersfield	2.15	"	415
2282	" Fresno	5.30	"	293
2303	*Arrive* Madera	6.20	"	278
2303	*Leave* Madera	6.25	"	278
2484	*Arrive* Oakland Pier	11.20	"	14
2489	" San Francisco	11.45	"	12

of the new "Sunset Limited" train, just put in service by the Southern Pacific Co. The time table is printed according to the day and night system, and explains it much better than any description could do. Its value as an aid to clearness is especially evident where the time of a long run is to be followed. The time table itself is of interest however, as this fast trans-continental train of the Southern Pacific Co. takes rank as one of the very fastest of long-distance express trains, and in the length of its run is probably excelled by no express train in the world save those of the Canadian Pacific Ry. between Montreal and Vancouver, 2,906 miles.

The showing of the altitude on the time table is a feature of interest to travellers which might be more frequently introduced on time tables of through trains. We notice, however, that for some reason, probably a mere oversight, the points of change of time are not noted on the card.

This new day and night system of printing time tables has already been put in use by the Chicago & Eastern Illinois, Evansville & Terre Haute and Louisville, New Albany & Chicago railways.

TESTS OF THE CRUSHING STRENGTH OF 12-IN. CONCRETE CUBES.

In a recent report to the State Engineer of New York, on the project to build storage dams on the Genesee River, for the purpose of improving the supply of water to the Erie Canal, Mr. Geo. W. Rafter, M. Am. Soc. C. E., describes at some length a series of experiments to determine the compressive strength of 12-in. cubes of concrete made with both Portland and natural cements of American manufacture. These experiments were made primarily to determine whether the local stone and sand, and especially whether the natural cements made within easy shipping distance, were adapted to making a strong, durable concrete. In the accompanying tables, which we have compiled from the tables given in the report, will be found the more principal features of importance brought out by the experiments.

Both Portland and natural cement concretes were tested, six brands in all, viz., Saylor's, and Wayland Portland and Fayetteville, Buffalo, Akron and Norton's natural. The general physical characteristics of these cements, as shown by such tests as were made, are given in Table I. Both classes show a good average strength. The Portland cements are no stronger, compared with others of their class, than are the natural cements. None of the natural cements are what they should be in fineness. No figures are given regarding the fineness of the crushed quartz used, but the mechanical analysis of the Mt. Morris sand showed it to be pure quartz, clean and sharp. Its fineness was as follows:

Passed by No. 20 sieve	99.37%
" " No. 30 "	91.87%
" " No. 50 "	37.5 %
" " No. 100 "	3.75%

Four different stones were tested to determine their respective fitness as aggregates for concrete. One of these was a shale and the other three sandstones. Broken to pass a 2-in. ring, the percentage of voids per unit of measure were:

	Loosely shoveled	Tamped.	Mean.
Genesee shale	38.3%	31.6%	34.9%
Ridge quarry sandstone	46.2%	38.6%	42.4%
Portage " "	43.3%	37.4%	40.4%
Nunda " "	43.2%	38.5%	40.8%

The voids of the sand used in the tests were found to average 31.7% per unit of measure.

The number of 12-in. cubes tested was 174. In making the cubes, the stone, sand and lime were first measured out in proper proportions and the stone thoroughly washed. The sand and cement were then mixed dry and water was added in sufficient quantity to bring the mortar to a plastic state. The mortar was then spread on the broken stone and the whole thoroughly mixed, and placed in the molds. These molds were built of 3-in. oak plank, and the concrete was rammed into them in 3-in. layers. Duplicate blocks were made of each set, one going into water at a temperature of 60° and the other remaining in air at the same temperature. After the molds were filled they were in each case removed to the basement of the building, which had a moist atmosphere and was kept at a temperature of 60° F., until the concrete had set. The tops of the cubes were then evened off by a coating of cement mortar and the sides of the molds removed, but the bottoms were left underneath the blocks and were not removed until they were shipped for testing.

The tests were made between iron faces on the 1,000-ton testing machine of the Phoenix Iron Co. The faces of the blocks were trued by covering with a coat of neat cement and scraping with steel straight-edges. This dressing was found somewhat more difficult to make than the ordinary plaster of Paris coating, but it gave good results and the difference in cost was not material. The results of the tests are shown in Tables II. and III.

Table II. gives the result of each of the 78 tests made on natural cement blocks, while Table III. gives the results of 46 Portland cement blocks. These 46 blocks were selected (1) as giving the average results, and (2) because they enabled a comparison to be made between blocks left in air and in water. The ages of the blocks when tested were very irregular, running all the way from 69 days to 94 days for Portland cement, and from 62 days to 89 days for natural cement. In the case of the natural cement blocks this difference in age is of no moment, since the results were so irregular from other causes as to overbalance any effect that the difference in age would be likely to have. For the Portland cement the difference is of more moment, yet the increase in strength between 70 days and 90 days is small compared with what it is during the first 30 days after molding.

The most noticeable feature of the results is the extreme irregularity in the strength of the natural cement concretes. Of the 78 blocks tested, 25 failed to give any result, either being disintegrated or breaking under light blows of a hammer. Of these disintegrated blocks, 19 had been immersed in water, and six had remained in the air. One of the brands of cement seems to have had more failures than the others, but the character of the stone used as an aggregate has not shown any particular influence. A somewhat more regular result is shown by the blocks which gave tests. The harder Ridge, Portage and Nunda sandstones gave higher results than the shale, as a whole, and the same is true of the concretes richer in cement. Individual cements or aggregates, however, do not always show this regularity. Another noticeable thing is the low pressure under which the great majority of the blocks failed.

Taking these results in connection with the favorable results obtained from the Portland cement concretes and the many solid and entirely reliable works of natural cement concrete, the conviction is forced upon us that the tests are not reliable. Only a comparatively few tests have been made, or, at least, published, upon natural cement concretes, so that there are few records with which to compare these tests. Gen. Gillmore gives the average of two tests of concrete composed of 1 Norton's cement, 3 sand and 6 stone, as 765 lbs. per sq. in. at two years' age, and the same with 1½ sand at three years as 1,560 lbs. Tests made at the Watertown Arsenal gave for Rosendale cement concretes, with composition as above, compressive strengths of 1,021 lbs. and 1,544 lbs. per sq. in., respectively, at the age of 46 months. Isolated tests elsewhere show practically the same results for the same conditions. The results given in Table II. indicate that little dependence can be placed upon concretes made from these brands of cement, and, in fact, as these are good average natural cements, indicate that natural cement concretes are extremely unreliable, and this is certainly not true where the cements are properly tested and the construction of the concrete carefully supervised. They are not equal to Portland cement concretes, however, and in the proposed work for which the tests were made, the engineer rightly says that natural cement concretes should not be considered.

Assuming that both classes of cement were fairly treated, and there is no reason to doubt that they were, the causes for the failure of the natural cement concretes must pretty certainly lie in the cements themselves. Aside from the tests given in Table I., there is little to indicate the character of these cements. It is stated that the cements were all submitted to Faija's hot test, and that both brands of Portland cement stood the test perfectly, "while the results indicate that none of the natural cements tested would be satisfactory for important dam work, such as we are now especially considering." Experiments were also made in a rough way to determine whether these concretes would stand freezing weather when freshly made. For this purpose the surplus quantities of each mixing were made into a series of 3 ft. cubes; these cubes being built up in thin layers well rammed, from day to day, as the other test cubes were finished. Some of these cubes were of Portland or natural cement entirely, while others were made up of layers of both classes of irregular thickness. The blocks were made during temperatures varying from 14° F. to 60° F., but generally between 25° F. and 40° F., and the result was that while the Portland cements appeared hard and entirely uninjured, the

natural cements had disintegrated and crumbled in every instance.

Turning to Table III., it will be noticed that a higher strength was quite generally shown by the blocks which had been kept in water. Tests made to determine the compressibility of the different concretes showed, as was to be expected, that the blocks in which the shale had been used as the aggregate were much the more compressible.

In conclusion, it may be mentioned that Mr. Rafter advises, should concrete be used for this reservoir construction, that it be laid in large blocks, or sections, separated by proper partitions, and that the spaces between blocks be filled after the work had hardened. It was also considered that only Portland cement should be used and that the shale rock should be used only for concrete such as would be used for lining the bottom of the reservoir, filling cross ditches, etc. Either of the other stones is considered a suitable material for a first-class concrete.

TABLE I.—Results of Tests of Cement Mortars Used in Making 12-in. Concrete Cubes for Compression Tests.

Brand of cement.	P. c. of water to mortar.			Tensile strength at 7 days, lbs. per sq. in.		Tensile strength at 28 days, lbs. per sq. in.	
	Crushed quartz.	Mt. Morris sand.	Prop. of sand to cement.	Crushed quartz.	Mt. Morris sand.	Crushed quartz.	Mt. Morris sand.
Saylor's.....	..	..	Neat.		471		490
"	30	35	1 to 1	329	252	455	317
"	37½	37½	2 to 1	247	178	367	258
"	41½	50	3 to 1	147	152	239	231
"	62½	75	4 to 1	114	128	156	191
"	62½	75	5 to 1	77	101	111	142
Saylor's: 100% passed 2,500 sieve; 97½%, 10,000 sieve; beginning of set 9 min., end of set 16 min.							
Wayland		30	Neat.		542		623
"	30	35	1 to 1	436	363	516	442
"	37½	44	2 to 1	324	335	421	417
"	50	58	3 to 1	190	189	271	280
"	50	87½	4 to 1	155	156	233	227
"	50	87½	5 to 1	127	132	152	172
Wayland; 98¾% passed 2,500 sieve; 87½%, 10,000 sieve; beginning of set 25 min., end of set 44 min.							
Buffalo		30	Neat.		119		197
"	35	40	1 to 1	119	107	...	199
Buffalo: 90% and 80% passed 2,500 and 10,000 sieves; beginning of set 12 min., end of set 20 min.							
Akron		30	Neat.		99		235
"	40	40	1 to 1	120	103	231	187
Akron: 85% and 73¾% passed 2,500 and 10,000 sieves; beginning of set 22 min., end of set 37 min.							
Fayetteville...		30	Neat.		112		183
"	35	40	1 to 1	131	99	334	218
Fayetteville: 90% and 80% passed 2,500 and 10,000 sieve; beginning of set 10 min., end of set 16 min.							

TABLE II.—Results of Compressive Tests of 12-in. Cubes of Natural Cement Concrete.

(Figures give crushing strength in lbs. per sq. in.)

Brand of cement.	Shale, set in.		Ridge, set in.		Portage, set in.		Nunda, set in.	
	Water.	Air.	Water.	Air.	Water.	Air.	Water.	Air
Proportions: 1 cement, 1 sand, 42% stone.								
Fayetteville...	224	202	370	314	0	314	...	...
*Buffalo	...	...	...	...	0	829	...	...
Akron	...	...	...	...	919	583	...	...
Norton's	0	336	706	515	784	515	...	...
Proportions: 1 cement, 1 sand, 42% stone.								
Fayetteville...	0 and 235	202	0 and 112	403 and 168	0**	0 and 247	0	314
Buffalo	0	269	0	471	706	560	672	471
Akron	471	448	594	471	0	381	773	448
Norton's	0	291	0	0	0	336	...	...
Proportions: 1 cement, 3 sand, 42% stone.								
Fayetteville...	314	314	0	...	0	...	269	...
Buffalo	0	336	0	381	538	381	515	381
Akron	0	359	0	381	381	314	381	269
Norton's	0	202	0	235	...	...	...	...

* Two cubes of Buffalo cement concrete crumbled, aggregate not given. ** Two blocks made, both crumbled.

TABLE III.—Results of Compression Tests of 12-in. Cubes of Portland Cement Concrete.

(Figures give crushing strength in lbs. per sq. in.)

Kind of cement.	Shale, set in.		Ridge, set in		Portage, set in.		Nunda, set in.	
	Kind of stone used.							
	Water.	Air.	Water.	Air.	Water.	Air.	Water.	Air
Proportions: 1 cement, 1 sand, 33% stone.								
Wayland ..	1,569	1,300	3,709	3,339	2,958	3,339	2,689	2,891
Saylor's ..	1,367	1,501	3,451	3,025	3,126	2,308	....	....
Proportions: 1 cement, 3 sand, 42% stone.								
Wayland ..	....	....	1,602	1,210	1,860	1,658	2,308	1,681
Saylor's ...	941	784	1,613	1,389	1,636	1,501	1,725	1,389
Proportions: 1 cement, 4 sand, 42% stone.								
Wayland ..	....	....	1,636	1,367	1,524	1,322	1,233	1,098
Saylor's ...	661	627	....	....	1,109	1,154	....	....
Proportions: 1 cement, 6 sand, 42% stone.								
Wayland ..	695	482	....	....	986	683	....	....
Saylor's ...	471	381	....	....	807	650	....	....

A GREAT WATER-POWER DEVELOPMENT ENTERPRISE AT OGDEN, UTAH.

By W. P. Hardesty, C. E.

The field for the development of water power has been rapidly extending during the past few years in all parts of the world. Not only have marvelous improvements been made in the electrical transmission of power, but the development of the water power itself has been materially cheapened and rendered more efficient by the invention of the Pelton wheel and the use of sheet-metal and wooden stave pipes for conduits carrying water under pressure.

All through the mountains of the West are streams of water with good fall, which are capable of supplying enormous amounts of power. Very few of these, however, are near enough to large cities, or other places where there is a large demand for power, to warrant their development. At Ogden, Utah, however, there is found in combination a large field for the use of power with ready means of developing and supplying it. Ogden is the most prominent railway center in Utah, and is only excelled in size by Salt Lake City. The Ogden River issues from the Wasatch Mountains just northeast of the city, and flows west through the north part of the city, emptying into the Weber River.

Like most other streams of the Wasatch Range, the Ogden runs through a narrow canyon with rapid fall for a few miles before reaching the plains, the country opening out with much less fall and gentler side slopes above the canyons. The river has a drainage area of 350 sq. miles, with a yearly run-off of 18 to 24 ins. The fall in the canyon spoken of is about 80 ft. per mile for five miles. The requisites of ample supply of water with rapid fall for securing a large power are thus at hand.

Use has been made of portions of the stream before, at times, for power for small local enterprises; but only within the past year or two has there been an intelligent attempt to develop and secure the full benefits of all the power now going to waste. Some preliminary surveys and designs were made in the summer of 1893, and in November of the same year, the Pioneer Electric Power Co. was organized. This is a Utah company entirely, and includes in its directorate and managing officers the most prominent officials in the Mormon Church. Mr. C. K. Bannister, of Ogden, is the Chief Engineer, and under his charge thorough surveys have been made, and complete plans have been worked out for all parts of the system. In designing the power plant and machinery, he has been ably assisted by Mr. R. N. Morse, draftsman, who has had much experience in work of this kind.

It is desired by the company to develop 10,000 net HP.; and to do this it will be necessary to supplement the low-water flow of the Ogden River with storage. The average low-water flow in the canyon is about 140 cu. ft. per second. A supply of 250 cu. ft. per second is needed to develop 10,000 HP. with the available fall that can be economically used. Thus storage must be supplied sufficient to furnish a flow of 110 cu. ft. per second for 90 days in addition to the low water flow. The river reaches its maximum flow in June, and its minimum is about Sept. 1 Though the deficiency under 250 ft. per second lasts over 90 days, the amount needed will only equal the flow of 110 ft. per second for 90 days.

Reservoir Site.—At the head of Ogden canyon the valley widens out, and the fall of the river becomes much less, being only about 10 ft. per mile for some distance, and everything combines to make here a natural reservoir site. About 1½ miles above the head of the canyon is the junction of the north, middle and south forks of the river. A dam placed at the head of the canyon will create a reservoir, backing the water up the broad main valley and the valleys of the three forks in addition.

A dam site was selected just within the canyon and a few hundred feet below the mouth of Wheeler's creek, which comes in from the south here. Other sites had been examined, but this was much the best. Five-foot contours from 10 ft. up to 55 ft. above the assumed elevation of 4,800 ft. above sea level were run. Of these, the 45-ft., 50-ft., and 55-ft. contours enclosed areas of 1,214, 1,470 and 1,524 acres respectively. The 45-ft. contour was adopted for the high-water mark. The area to be segregated for the reservoir is 1,371 acres, including considerable land outside of the reservoir, in order to avoid irregular cuttings of land-holdings. This will back the water up more than three miles, and will give a storage capacity of 1,356,000,000 cu. ft., with an average depth of 25 to 26 ft. Due allowance is made for evaporation, 18 ins. being allowed for July, August and September, the three months when the reservoir is most used, when the loss will amount to about 80,000,000 cu. ft. The waters of the river are generally fairly clear, so the deposition of sediment will be a small factor. The total discharge of the stream during March, April, May and June, when most sediment is carried, averages 13,600,000,000 cu. ft., and of this it is estimated that only 3,700,000 cu. ft. is sediment, based on the proportion of 275 parts in 1,000,000. The site will be well cleared and grubbed. The county road leading up the valley will be changed to run above the water line.

Dam.—The dam-site at the head of the canyon is about 8 miles east by northeast from the center of Ogden. The dam is to be of masonry, designed on the lines of Wegmann's No. 2 type, and will be 60 ft. high by over 450 ft. long, and will contain about 19,000 cu. yds. of masonry. It will be carried to bed-rock, and this will require excavation of about 20 ft. depth of detritus for about two-thirds its length. Where the distance to bed-rock is over 60 ft. (about half the length), foundations of rubble or concrete will be carried up to the regular section. The crest will be 55 ft. above the present low-water level of river. Test pits and drifts have been dug to outline the bottom, and it is known that the maximum depth of bed-rock is about 82 ft.

The dam will be constructed on a 9° curve (radius of 637 ft.) with curvature up stream, partly for arch action, but also for stability against overturning, as it brings the up-stream top corners in the same straight line with the bottom of the dam in the middle on the down-stream side. The ends of the dam will have the solid rock ledges as abutments. The dam is to be of rubble masonry laid in concrete, with granite facing, and Portland cement mortar will be used throughout.

The following are the general dimensions: Top width, 6 ft., carried down 5.62 ft. to level of top of waste-way, face then curved with 18 ft. radius to join the straight slope of about 2 to 3. Back is perpendicular for 18 ft. down, then battered 1.12 ft. in 18 ft. more, then straight down for the remaining 24 ft. The bottom is 39.66 ft. broad, and the lines of pressure for reservoir full and reservoir empty fall just within the middle third in either case. The center of gravity is 39¼ ft. below the top and 13.30 ft. from the back of the wall. The thrust is 112,500 lbs. per lin. ft. with water at top of dam. The weight of masonry to resist the thrust is 172,224 lbs., taking weight per cu. ft. at 144 lbs., which is rather less than the actual. With these conditions, the maximum pressure that can come on any part of the base is about 4½ tons per sq. ft. The area of the section is 1,196 sq. ft. The ends of the dam are drawn in at bottom towards the stream, with a batter of about 1 to 4. The elevation of the crest above sea level is 4,843.69 ft.

There are to be two waste-ways of 50 ft. each on the dam near the south end. These are separated by the pier of a bridge which is to span them. They have a clear height of 5.62 ft. to the top of the dam. The top of the waste-way is well rounded off to afford the least resistance to the water; the straight slope on the face is even with that of the rest of dam, except at the bottom, where it is rounded off with a radius of 24 ft. to discharge the water horizontally. The thickness of masonry at the end of the toe thus formed is 5 ft., and the width of the bottom of the dam here is 49.16 ft. Bulkheads at sides confine the flow down the face of the dam to the waste-way alone.

A depth of water flowing over the crest of waste-way of 3.62 ft. will secure a flow of 2,300 cu. ft. per second, this being about the maximum discharge of Ogden River of which there is any record. If covering the remaining 2 ft. to the top of the dam, the flow would be very nearly doubled. The stone used in the body of the dam will be quartzite, obtained near by.

Inlet Tower.—The inlet tower will be located near the north end of the dam, and is designed to control the outflow of water at different depths in the reservoir. It will connect with a tunnel about 250 ft. long leading from its bottom around the north end of the dam, making a half circle, and ending in an outlet chamber below the dam. The tower will have a clear depth of 60 ft. from the floor of its house (at the level of the top of the dam) down to the bottom. It will be built of masonry,

with a horizontal section of hexagonal shape outside and circular inside, the inner diameter being 10 ft. The walls batter from 2 ft. 9½ ins. in least thickness at the bottom to 1 ft. 6 ins. at top. The tower will have inlet gates, one on each face of the wall, and each 6 ft. in diameter. The outlet tunnel will be circular, and 8 ft. 6 ins. in diameter in the clear, and will have its center 6 ft. 3 ins. above the bottom of the tower. The inlet gates will be in three pairs, the two of each pair being at the same elevation and on opposite sides of the tower. The pairs will be placed at intervals of 8 ft., 12 ft. and 12 ft. above the center of the tunnel.

Each gate will be lifted by two chains attached to a winch at the top of the tower. In operation, when any gate under pressure is to be lifted, the water in the tower will be brought to the outside level by means of the other gates, or a small auxiliary valve, thus equalizing the pressure and allowing the use of simple winches.

The outlet chamber will be of riveted steel plates, and will have 6-ft. gates, one controlling the flow to the conduit and the other discharging waste-water back into the river. A novel feature of these two gates is the method by which they are operated. The power to do this is supplied by Pelton wheels, each gate having a No. 5 wheel (24 ins. diameter) operated under a 40-ft. head of water supplied from the reservoir, under which each wheel will develop 1.89 HP. The shaft of the wheel will be connected by bevel gearing to the stem of the valve, thus securing easy operation.

Wooden Pipe Conduit.—The 6-ft. wooden stave pipe begins at the outlet chamber and extends through the canyon for nearly 5 miles. Most of the canyon is extremely difficult to build any structure through after getting 20 or 30 ft. up from the bottom, having steep rocky sides. The line lies on the north side all the way. It is estimated that about one-third of the excavation for the conduit line will be in solid rock, besides 1,190 ft. in tunnels. The pipe will cross several deep gulches on trestles. For laying the pipe a trench 8½ ft. wide at the bottom will be made, with slopes of 1 to 2 in earth, and 1 to 10 in rock. Sills 8 ft. apart will be placed crosswise, to more securely support the pipe. Each sill will be 6 × 6 ins. × 8 ft., with a chock placed on top, curved to fit the bottom of the pipe.

Rock cuts are carried 6 ins. below grade to allow filling in for an even support to pipe. The minimum covering of earth on top will be 2 ft., that being deemed sufficient for protection. The wooden pipe is proposed for use for all heads up to 180 ft., that being considered about the limit up to which it is economical and safe. Two hydraulic grade lines are established leading from the reservoir, one for the reservoir full and the other, 42 ft. lower, being for it empty. The pipe, of course, has to be kept below the lowest one. These lines fall on a grade of 0.2%, or 10.56 ft. per mile. The capacity of a 6 ft. pipe with this fall is estimated at 250 cu. ft. per second. All pipe, of course, has to be constructed to stand the pressure due to the upper hydraulic grade line.

There are to be three tunnels on the line. The first, of 85 ft., will be well up toward the head. At a point four miles from the head there will be an 825-ft. tunnel. This is through a steep rocky ridge, with the summit 300 or 400 ft. above the line. About three-fourths of a mile further on, and just before descending the face of the mountain to the broad plain below, the third tunnel, 280 ft. in length, will be located. A novel feature here is the over-flow or relief shaft. This shaft is to lead from the surface over the middle of the tunnel down to it, and will serve as a stand-pipe, to let the water rise to the proper level and overflow. In order to limit pressures to those due to the upper grade line, this over-flow is put in, the top being just 4 ft. above upper line, so when water is shut off at the power house, the excess will escape through this shaft and will not cause any excessive pressures in the upper or wood-pipe portion of the line. The tunnel section will be about 64 sq. ft., or 2.42 yds. per lin. ft., being 8½ ft. wide, 7 ft. high to spring line and with rise of arch of 1 ft. The pipe will be laid through the tunnels unless the rock is of a more favorable or close formation than is anticipated.

The maximum curvature for all horizontal curves of the pipe is 12°, and for vertical curves 6°. As it would require high trestles to cross many gulches with this limit of vertical curves in the pipe, the sharp bends are made by elbows made of riveted sheet steel with radial joints, like elbows for stove pipes. These are made with an actual radius of about 8 ft., but it is not thought they will have any material effect on the flow. Sixteen of these elbows will be used. The trestles used will be built like standard railway trestles.

The greatest dip on the line of the wooden pipe is 135 ft. below the lower grade line. The pipe on the trestles is to be well boxed in to protect it. Sets of automatic air valves will be placed at all the prominent summits, 18 in all on this section, with 10 valves each. In place of the ordinary cluster valve it is proposed to use a "series" type, furnished by Dunham, Carrigan & Hayden, of San Francisco. The 6-in. cast iron connection pipe has leading upward from it on an incline a 6-in. pipe, along the top of which in a row are the ten 2 in. valves. The idea is that with this arrangement the action will be more gradual and with less shock, the valves operating one slightly after the other in quick succession. There will be 17 8-in. Eddy gate blow-offs at different depressions along the line, with cast iron connections. These and the air valves will have wooden housings.

There will be about 24,600 ft. of wooden pipe. This wooden stave pipe has been used to a considerable extent throughout the West for a number of years, and its great value and low cost for light and medium heads have been pretty well demonstrated. For heads above 150 to 200 ft. iron is preferable, and with present prices of iron the difference in cost is not much for sizes up to 18 ins. to 24 ins. The pipe used will be either of the Durelle or the Allen patent, and will be 72½ ins. interior diameter, with staves 2 ins. thick, banded with ⅝-in. steel bands.

In the first patent the staves are plain on the inside, forming a polygon, and curved on the outside; the side joints between the staves are radial but interrupted by an angular tongue and groove to intercept leakage. The staves are 16 ft. to 20 ft. long and do not break joints but are built in sections, the junction of which is made by an extra circle of 4-ft. staves on the outside, which also makes these end joints water-tight. The staves for this size pipe would be 7 7-16 ins. on the outside by 7 ins. on the inside and 2 ins. thick, there being 32 to the circle. In the Allen or older patent, the staves have both inside and outside curved truly, have plain radial joints for the sides and break joints for the ends, the ends having a metal clip inserted in saw kerfs to make a better connection. (Eng. News, Jan. 5 and Feb. 16, 1893.)

The material will be either California redwood or Texas pine. The spacing of the band is graduated to the pressure, and a factor of safety of 4 is used for all pipe, both wood and metal. The strength of bands is designed to be equivalent to that of a double riveted sheet metal pipe, as shown by the following formula used in computing them:

Let t = thickness of sheet metal in inches.
" A = area of cross section of band in sq. ins.
" x = distance c. to c. of bands in inches.

$$t = \frac{\text{Press. in lbs. per sq. in.} \times \text{radius of pipe in ins.}}{\text{Safe working strength of metal (lbs. per sq. in.)}}$$

$$x = \frac{\text{Safe working strength} \times A}{t}$$

The staves are always of ample strength to take the strain between bands.

The following is a table showing the spacing from 40 ft. (the least head sustained) up to 100 ft.:

Head, ft.	Spacing, ins.	No. ⅝-in. bands per 100 ft.	Head, ft.	Spacing, ins.	No. ⅝-in. bands per 100 ft.
40 to 45	4 11-16	256	70 to 75	2¾	436
45 " 50	4⅜	290	75 " 80	2 9-16	466
50 " 55	3¾	326	80 " 85	2 7-16	496
55 " 60	3 7-16	349	85 " 90	2 5-16	527
60 " 65	3 3-16	376	90 " 95	2 3-16	553
65 " 70	3	400	95 " 100	2⅛	580

For heads over 100 ft. a ¾-in. band will be used.

Steel Pipe Conduit.—After reaching the face of the mountain the pipe line will descend for about 900 ft. with a rapid and uniform fall to the bottom, where the head is 350 ft. From here on to the site for the power house is some 4,500 ft., and the fall is gradual and over a smooth country. The length of the entire conduit is not quite 6 miles.

After reaching a head of about 180 ft. on the mountain side the steel pipe will be used. This is to be of double riveted steel plates, proportioned for strength by the usual formulas and based on 68% of the full strength being retained at the riveted joint. The metal must have a tensile strength of 55,000 to 65,000 lbs.; elastic limit, 40,000 lbs., and elongation 25% in 8 ins.

The following is a table showing thickness, weights and lengths for different strengths of pipe, with limits of head they are to be used for:

Thickness of plate, ins.	Wt. of pipe, per lin. ft., lbs.	Length, ft.	Maximum head, ft.
⅜	290.7	160	251
7-16	337.9	100	286
½	380.	80	336
9-16	437.	1,710	421
⅝	415.	850	436
11-16	532.	2,000	460
		5,560	

The spacing, etc., of rivets for 11-16-in. plate will be as follows: 1-in. rivets, 2⅝ ins. long in clear; for longitudinal seams, spaced 3⅝ ins. with rows 2½ ins. apart and 1⅝ ins. to edge of plate; for circumferential seams, spaced 2⅜ ins. with 1⅝ ins. to each edge, giving 3¼ ins. lap.

Three air valves and two blow-off valves will be used on the steel pipe. There will be eleven elbows at the sharp angles. At the entrance to the power house there will be a 6-ft. gate, and five relief valves will be placed along the receiver here. The maximum static head at the power-house is 512 ft., of which 62 ft. will be consumed as friction head with full supply, leaving 450 ft. as the effective head.

Power House and Machinery.—The power house will be situated in the northeast part of the city on the north side of the river. The dimensions and internal arrangements will depend somewhat on which of three electrical systems—the General Electric, the Westinghouse or the Siemens-Halske—is used. For the first or second the inside will be 51 ft. × 105 ft.; for the third, 54 ft. × 115 ft.

The general plan is to have a receiver laid along the south side of the building in the basement, leading from which will be pipe to supply each of the Pelton wheels with water. This receiver is a continuation of the pipe, but enlarged to 7 ft. diameter. It will be of 1-in. riveted steel plates, and 108 ft. long. There are to be ten 16½-ft. Pelton double-nozzle wheels, each coupled direct to a dynamo of 12 ft. to 14 ft. diameter. The usual speed will be 100 revolutions per minute. The Pelton wheels will have 11-in. buckets, and each wheel has a theoretical capacity of 1,278 HP. with an effective head of 450 ft. and a supply of 25 cu. ft. per second.

Each wheel will easily develop 1,000 HP., figuring the efficiency at 80%. These ten sets of wheels and dynamos alternate with each other in a staggered arrangement along the building; that is, there are two rows of machines, the first 17½ ft. from the center of the receiver, and the second 16 ft. further on. A 16-in. pipe leads from the receiver to the connection with the double-nozzle for each wheel; the discharge water is received by a large drain at the bottom of each wheel pit and conveyed outside the building. The feed pipes spoken of pass through a wall in front of the wheel, intended to catch back-splash of water. The feed pipes or nozzles are to have 14-in. throttle valves.

The hydraulic plant is to have the attachments of short and long tapers, water-relief valves, differential governors, constant speed motor with automatic governor and everything needed for complete control of the machinery.

The power house will have an equipment for machine-shop work, and a large traveling electric crane with a capacity of 30 tons, running lengthwise of the building and used for handling all the heavy machinery. The ten direct-coupled generators for electricity will have a capacity of 1,000 HP. each. It is not yet decided whether direct or alternating currents will be used; probably both. No transforming of the current will be done, as the power will be supplied direct from the power-house. It is estimated that three-fourths of the power generated can be used within three-quarters of a mile of the power-house, and the other one-fourth within three miles. It is figured that use for 2,200 HP. can be found under present conditions in the city of Ogden. The remainder will probably be taken by various industrial enterprises to be established there. All the north part of Ogden along the broad valley of the Ogden River affords excellent sites for manufacturing enter-

prices, and the city is the terminus and junction point for five important railways, thus securing excellent transportation facilities.

The following is a summary in round figures of the estimate of cost of the entire system, including wiring for supplying consumers:

Reservoir	$85,000	
Dam and all appurtenances	235,000	
Total, head works		$320,000
Wooden pipe conduits	$260,000	
Steel pipe conduits	165,000	
Total conduits		$425,000
Power-house	$37,000	
Hydraulic machinery	40,000	
Electrical machinery	240,000	
Total generating and supply plant.		$317,000
Engineering and contingencies		50,000
Grand total		$1,112,000

Besides its supply of power, the company expects to make the irrigation of land an important adjunct to its business. After use for power the water is to be returned to the river, and can then be used for other purposes. The 110 cu. ft. per second supplied by the reservoir during the summer will remain the property of the company after being returned to the stream. The natural low water-flow, averaging 40 cu. ft. per second, is already appropriated further down the river, and of course has to be returned to the stream. The company has purchased another ditch several miles down the river, with an excess or surplus water-right of 100 ft. per second, and with all the water at hand expects to irrigate some 18,000 acres. Water-rights here are worth about $20 per acre, and the company has already exchanged water-rights for 4,000 acres of land on the basis of an even exchange, water-right to one acre for one acre of land.

CANAL BOAT PROPULSION IN IRELAND.

For the last two or three years experiments have been made on the Ulster and Newry canals, in the North of Ireland, in propelling canal boats fitted with twin-screw propellers with adjustable immersion. A paper was lately read upon these experiments by Mr. Henry Bancroft, of Newry, before the British Institution of Mechanical Engineers, and from it the following items are gathered:

The last boat fitted up, the "Newry," is 62 ft. long, 11½ ft. broad, 5 ft. draft, and, inclusive of machinery, carries a load of 65 tons. Her machinery weighs about 3 tons and consists of one locomotive boiler, with 87 sq. ft. of heating surface and one horizontal engine with two 4½-in. cylinders and 8-in. stroke. The engine is placed immediately forward of the stern post, with the boiler in front of the engine. On each side of the engine and coupled to the crank-shaft are 12-in. skew-wheels (or worm gearing) driving wheels of the same diameter and twice the number of cogs fixed on upright shafts securely fastened in a framework. At the lower part of these shafts bevel wheels communicate motion to the two 2½-in. propeller shafts, fitted with thrust collars and working in patent axles, filled with oil similar to those used on road carriages.

The twin propellers are each 4 ft. 10 ins. in diameter and have three blades with an area of 4 sq. ft. each, or 24 sq. ft. in all. The blades are made of thin steel, riveted to arms, which latter are screwed into the boss. The pitch of the blades is equal to 1,000 revolutions per mile, the dimensions of the blade being arrived at after numerous experiments. The crew consists of a man and a boy, who have no difficulty in working the craft.

The "Ulster," a similar boat, built one year ago, has now made 3,000 miles, and both boats are very efficient as tugs. The "Ulster" has towed a coal lighter through the Newry and Ulster canals, a distance of 46 miles, with a combined cargo of 107 tons. Of this distance 13½ miles was made in 4½ hours, with a coal consumption of 2½ cwt. The propellers, which have never been fully submerged, can be readily raised and lowered, independently, by lifting the upright shaft and propeller by means of a long screw attached to a crane on the stern of the boat, after unclamping the upper driving wheel. It was found that with a full boat, with 5½ ft. draft, an immersion of 3¼ to 3½ ft. was best, measured from the surface of the water to the bottom of the propeller.

The Grand Canal Co., of Dublin, fitted a lighter with similar machinery and, with another lighter in tow, made the trip of 158 miles from Dublin to the Shannon and back, with 78 locks, in about six days. The coal consumed on the double trip amounted to 3 tons, at $3.48 per ton, or less than 3½ cts. per boat per mile. Working day and night, with relays of horses and men, the regular charge on the Grand Canal is 24 cts. per boat per Irish mile, or nearly 19 cts. per boat per English mile. Petroleum engines and electric motors for conveying power, in combination with an oil engine, are suggested as applicable to this machinery.

BRUSH AND ROCK DAMS AND SHORE PROTECTION ON THE MISSISSIPPI.

A considerable amount of river improvement work is to be done on the Mississippi River in Illinois, Wisconsin and Iowa, in the construction of brush and rock dams and shore protections. The following particulars of the work are from the specifications issued by Maj. S. Mackenzie, U. S. Engineer Office, Rock Island, Ill.:

The dams will consist of brush made into fascines and loaded with rock. The fascines may be laid one at a time or in mats, except in places where the water is over 2 ft. deep, when they must be made into mats. Where only one layer of brush is laid, the covering of rock will be 1 ft. thick at the tips and butts, and 2 ft. at the middle of the dams, if required. When more than one layer of brush is used, the bottom layer will be covered with rock 6 ins. thick at the upper side, and 18 ins. at the lower side, if required. On this rock a second layer of brush will be laid, 10 or 15 ft. (as may be required) farther up stream than the lower layer, and this second layer will be fastened and covered as the lower. Additional layers will be similarly placed and covered, except that each will be placed and laid 2 ft. farther up stream than the one immediately below it, and the top layer will be covered with rock, where a single layer of brush is used. When required, the fascines and mats will be fastened by stakes. When laid upon a dry bar, a trench 12 to 18 ins. deep will be excavated for the reception of the mats or fascines, if required.

The shore protections will consist of a layer of fascines made into mats, sunk at the foot of the slope of the bank, extending out into the river and up the slope as far as may be necessary, with a covering of rock from 9 in. to 2 ft. thick, evenly and compactly laid. The upper portion of the slope will be covered with rock alone, unless otherwise ordered. The bank to be protected will be trimmed to a regular slope of 1 to 2, and all trees, stumps, snags, etc., removed, before the protection is laid. The cost of all trimming, clearing and snagging, either for shore protections or dams, will be included in the price of brush and rock per cubic yard.

Fascines are to be made of live brush, well trimmed and closely choked, 20 ft. long, and from 12 to 15 ins. diameter, and tied with bands of tarred rope or wire not more than 3 ft. apart. When made into mats they will be closely packed, and secured by at least three pairs of binding poles, joined by ties of tarred rope or wire not more than 2 ft. apart. Mats will be from 12 to 15 ins. thick, and not less than 12 ft. long.

The rock is to be of a kind that will not disintegrate on exposure to the action of the water and atmosphere; its minimum size for top covering and shore protections is to be 6 ins. cubed, or an equivalent thereto, and not larger than 10 ins. cubed, or its equivalent. A sufficient amount of small rock or gravel must be furnished to fill all interstices and form a compact mass.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

ALPENA & NORTHERN.—This railway has been extended to Jackson Lake, 55 miles north of Alpena, Mich.

BANGOR & AROOSTOOK.—Moses Burpee, Ch. Engr., Houlton, Me., writes us that the grading along the whole line to Presque Isle as well as the extension of the same to Caribou, Me., 15 miles further, making 60 in all on the main line, and the 13⅓ miles of Fort Fairfield branch, has been completed, with the exception of two or three points of heavy work, which will all be finished in the next two weeks. Only a few men are now engaged on grading, as the work is practically finished. The end of the track is now about two miles from Presque Isle village. The temporary trestle across Aroostook River, about one mile north of Presque Isle, will be finished probably about the end of this month, when tracklaying will proceed without delay to Caribou.

BROOKLINE & MEDFORD.—The construction of this railway in New Hampshire has been finished by Ward Bros., Rumford Falls, Me., and the line will be opened for traffic Nov. 15.

CAMMAL & BLACK FOREST.—C. B. McCullough, Ch. Engr., Cammal, Pa., writes us that 10½ miles of this railway has been graded and 10 miles of track laid. About 155 men are now at work on the line. The route is from Cammal, on the Fall Brook road, to the county line, and it is proposed to build 16 miles this year. Pres., R. M. McCullough.

CANADIAN PACIFIC.—Tracklaying has been completed for 43 miles on the Lake Temiscamingue road, and it is reported that the line will be completed by Dec. 15. It extends from Mattawa station to lakes Temiscamingue and Kippewa, in northern Quebec.

FREDERICK & CHARLEVOIX.—Geo. Crocker, Gen. Man., La Porte, Ind., writes us that this railway is completed from Frederick, on Michigan Central, to Alba, Mich., 25 miles, as noted in our issue of Oct. 25. No trains will be run until next season. The road is built in a first class manner, with 60-lb. steel rails, standard gage, and with steel girder bridges. The grading on over 100 miles of additional spurs and main line is completed.

GENESEE & WYOMING VALLEY.—P. H. De Witt, Ch. Engr., York, N. Y., writes us that the construction of the extension of this railway is progressing rapidly and will be completed in about 30 days. The route is from Retsof northwardly to Caledonia, Livingston county, a distance of 12 miles.

INTERCOLONIAL.—Press reports state that the department of railways and canals, Ottawa, is preparing to receive bids for the construction of the Dartmouth Branch of this railway, about 11 miles in length, which has been projected for some time.

MONTFORT COLONIZATION.—This railway was formally opened Oct. 27. The line extends from St. Sauveur, Que., north of St. Jerome, northwest by of the Montfort orphanage, to Arundel, Que., about 33 miles, for which distance a subsidy has been granted. The road has a 3½-ft. gage and is completed for 21 miles. The line has been surveyed to the Gatineau River, and will probably be extended in the near future. Pres., Eusebe Senecal; Vice-Pres., Jos. Brunet; Messrs. Froideveaux, G. Chapleau and E. Deborchen, directors, Montreal.

RUMFORD FALLS & RANGELEY LAKES.—The contract for grading the first 18 miles of this railway, as advertised in Engineering News, was awarded to Ward Bros., as stated in our issue of Oct. 11. We are informed that the grading will be about finished Jan. 1 and tracklaying commenced about April 10. The survey for an extension from Byron, Me., to Rangeley, 10 miles, will be commenced Jan. 1.

SEBASTICOOK & MOOSEHEAD.—Z. D. Lancaster, Pittsfield, Me., has obtained a controlling interest in this railway, and is now president of the company. The line extends from Pittsfield to Hartland, Me., eight miles, and it is reported that efforts will soon be made to secure an extension to Abbott.

UNADILLA VALLEY.—The track has been laid on this railway to Sweet's, 12 miles, and it is expected to complete the line to South Edmeston before winter. This will leave but four miles of the road to New Berlin to be built next year. The line is projected from Bridgewater to New Berlin, N. Y., a distance of 20 miles.

WEST VIRGINIA CENTRAL & PITTSBURG.—The Baltimore "Sun" states that J. C. Onderdonk has been engaged to survey a portion of the route surveyed some time ago by Chauncey Ives, Ch. Engr., from Cumberland to Hagerstown, Md., 79 miles. The road is projected as an extension from Cumberland eastward to a point a few miles north of Hagerstown, where it will connect with the Cumberland Valley. The line is intended to give an outlet to the seaboard and bids for the construction were received March 31 last, but after several weeks of delay it was decided to postpone the construction.

WISCONSIN & MICHIGAN.—J. E. Williams, Supt., Menominee, Mich., writes us that tracklaying on this railway was completed last week. The line extends from Peshtigo, Wis., through Mariette, Wis., Menominee, Mich., to Faithorn Junction, 60 miles, as noted in our issue of Oct. 25.

Projects and Surveys.

CARP, ALMONTE & LANARK.—Ottawa papers state that the township of Ramsay will vote Nov. 27 on a by-law to take $20,000 of stock in the Carp, Almonte & Lanark Ry. The line is to be built from Carpe to the first concession line of Ramsay within two years from the passing of the by-law, otherwise the money will not have to be paid. The money to pay the expense of submitting the by-law has been deposited with the treasurer of Ramsay, by the promoters of the new line. Almonte has already voted $40,000 to the project.

NEW AMSTERDAM, JOHNSTOWN & GLOVERSVILLE.—F. & J. Pimer, contractors, of Emporia, Pa., accompanied by Layton Caten, Gen. Man., and Hon. J. W. Green, went over the line of this projected railway last week. It is expected that work in some of the bridges and trestles will be commenced this week. Henry Hurst, Tribes Hill, N. Y., will do most of the stone work, and F. & J. Pimer will do the grading. It is estimated that the road can be built for $6,000 per mile.

PHILADELPHIA & PITTSBURG.—Two parties of surveyors are at work on the line of this road. It is reported that a large portion of the right of way has been secured and that contracts for the construction will be awarded next month. Pres., S. H. Hicks, Philadelphia, Pa.

SANDUSKY, ASHLAND & SOUTHERN.—It is reported that steps will soon be taken to secure the construction of this railway, which is projected from Sandusky through Norwalk, Ashland and other places, to Loudonville, Ohio. M. B. Hoxsey, Sandusky, O., and J. M. Hoxsey, Brooklyn, N. Y., are interested.

Southern—Existing Roads.

ATLANTIC, SUWANEE RIVER & GULF.—George Tompsett, Ch. Engr., Starke, Fla., writes us that this railway is projected from Alachua, through Wadis and Oceola to Trenton, Fla., 100 miles. The line is located to Oceola, 20 miles from La Cross, and three miles graded. The work is being done by the company. Pres., Bion H. Barnett.

CHESAPEAKE & OHIO.—M. E. Ingalls, Pres., Cincinnati, is reported as stating that $2,000,000 will be spent by this company in improvements at Richmond and Newport News, Va.

ILLINOIS CENTRAL.—A press report from Montgomery, Ala., states as follows: It is stated here that the Illinois Central has arranged to get the Savannah, Americus & Montgomery out of the receiver's hands and then secure the projected Montgomery, Tuscaloosa

& Memphis road. Arrangements have been made to float the bonds to complete the latter line with Illinois Central indorsements. This would give the system a through line from Savannah, Ga., by way of Montgomery, Ala., Grenada, Miss., and Memphis, Tenn., to Chicago. Railway men here believe the arrangements have already been virtually made.

LEESBURG, EMERALDA & NORTHERN.—C. S. Noble, Ch. Engr. and Supt. of Construction, writes us that this railway will be constructed from Leesburg, Fla., through Orange Bend, Lisbon and Higly to Emeralda, 16 miles. The line has been surveyed and grading is under way.

MOBILE & OHIO.—This company is reported as about to build a branch from Baldwin west to New Albany, Miss., about 25 miles, to tap new coal and iron fields.

NORFOLK & WESTERN.—A Roanoke, Va., despatch states that John Sexton, Roanoke, contractor for the construction of 12 miles of railway from the Norfolk & Western road into the Mountain Lake property, has sub-let four miles each to J. B. Saunders & Co., of Franklin county, Vaughan & Luck and H. O. Rogers, of Roanoke. The construction of the bridge for the road over New River, at Pulaski, was let to Mr. Gilliam, of the latter city. The road is to be completed by Feb. 1.

OPELIKA & AUBURN.—We are informed that this railway is completed to within one mile of Auburn. The line will extend from Opelika to Auburn, Ala., a distance of eight miles. Pres., M. E. Gray; Ch. Engr., John L. Cowan.

Northwest—Projects and Surveys.

MIDLAND PACIFIC.—Just one year ago press reports stated that this company had sold $25,000,000 worth of bonds and would construct its road at an early date. It is now stated that Senator R. F. Pettigrew, Pres., Sioux Falls, S. Dak., has contracted with Maj. G. B. Hibbard, New York, for the construction of the line from Sioux Falls, S. Dak., to Seattle and Tacoma, Wash., some 1,600 miles. Maj. Hibbard is quoted as saying that the first 400 miles to the coal fields of Wyoming will be built next year, and the road completed to Yellowstone Park in 1896, and the remaining sections as soon thereafter as possible. Surveys from Sioux Falls to Pierre, 214 miles, were completed more than a year ago.

Southwest.—Existing Roads.

CHOCTAW COAL & RY.—Bids for the construction of some 125 miles of the Choctaw, Oklahoma & Gulf road were opened in Philadelphia last week, according to press reports. Ch. Engr., J. F. Hinckley, South McAlester, Ind. T. Pres., Chas. Hartshorne, Philadelphia, Pa.

CORSICANA & SOUTHEASTERN.—C. W. Coykendall, Pres., Corsicana, Tex., writes us that the contract for building this railway has been awarded to R. H. Downey & Bro., Houston, Tex., as noted in our issue of Oct. 25, and that the construction is progressing rapidly. The road is projected through Fairfield, Buffalo and Beaumont to Sabine Pass, 350 miles, all in Texas. The contract for 65 miles between Buffalo and Huntsville will probably be awarded this month. F. C. Hand is chief engineer and superintendent of construction.

Projects and Surveys.

PERLA, PRINCETON & SOUTHERN.—Incorporated in Arkansas to build a railway from Perla, Hot Springs county, east to intersect the Wyandotte & Southeastern and thence south by way of Princeton to Bearden, on the St. Louis Southwestern, a distance of about 50 miles; capital stock, $400,000; incorporators, Adelbert Strauss, St. Louis; M. A. Nuisen, Malvern; Waldernan Stranss, Fordyce; W. A. Read, Malvern; F. W. Taussig, St. Louis.

POMONA, SILOAM & SOUTHERN.—Incorporated in Missouri to build a railway between Pomona and Siloam Springs, a distance of 10 miles; capital stock, $200,000; incorporators, H. D. Mackay, J. E. Kreybill and W. I. Kreybill, Pomona, Mo.; William Pitts, Freeburg, Ill., and John T. Pressley, E. H. Emerson and A. M. Pease, Siloam Springs, Mo.

SPRINGFIELD & HARRISON.—The citizens of Springfield, Mo., are considering a proposition of F. M. Garvin and E. M. V. Powell for the building of a railway from that city to Harrison, Ark. A bonus of $100,000 is asked.

WICHITA FALLS.—It is reported that the contract for building this railway from Henrietta to Wichita Falls, Tex., 18½ miles, has been awarded to L. J. Highland, Chicago, who has sublet the work to Bracey Bros. & Co., Chicago. The contract includes grading and tracklaying. Work will begin at once and it is to be completed by Jan. 1.

Rocky Mt. and Pacific—Existing Roads.

GREAT SALT LAKE & HOT SPRINGS.—This company is reported as about to extend its line from Centerville to Farmington, a distance of about four miles. H. S. Joseph, Ch. Engr., Salt Lake City, took a party of contractors over the route last week, according to reports.

MONTANA MIDLAND.—The Helena, Mont., "Independent," states that John Bradley, Wm. Quinn, Benj. Townsend and W. H. Green have been awarded the contract for grading and rock work on the 66 miles of this road between Castle and Toston, Mont., on the Northern Pacific. Contracts for bridges and about 1,100 ft. of tunnels will be awarded separately. The grading is to be commenced this week and be completed before Jan. 1, 1896. Some work on this railway was done last year, but the stringency of the money market caused the construction to be postponed.

NEVADA SOUTHERN.—It is reported that capitalists have become interested in this railway who will extend the line from Manvel, Cal., to Good Springs, 56 miles. Isaac E. Blake, Pres., Denver, the projector of the railway, is said to have resigned, but will retain an interest in the new company. Gen. Man., Robt. S. Seibert, Manvel, Cal.

SUMPTER VALLEY.—The Oregon Lumber Co., Baker City, Ore., owner of this railway, is reported about to extend the line about 25 miles into the timber and mining region southwest of Oregon City.

Projects and Surveys.

BOISE & SILVER CITY.—Committees have been appointed by residents of Boise City, De Lamar and Nampa, Idaho, to secure a railway to connect these cities.

Foreign.

MEXICO, CUERNAVACA & PACIFIC.—A press report from Cuernavaca, Mex., states that the department of public works of Mexico has just approved the location of the line of railway from that city to the port of Acapulco, on the Pacific Coast, a distance of 175 miles. The route of the road is through the towns Puente de Ixtla, Iguala, Taxco, Chilpancingo, and the richest agricultural section in tropical Mexico. Col. J. H. Hampson, of Mexico, Mex., and Kansas City, Mo., is president and general manager of the company.

STREET AND ELECTRIC RAILWAYS.

HINGHAM, MASS.—Sidney Cushing, E. F. Wilder and C. H. Marble have petitioned for a franchise for the Hingham St. Ry. Co. for an electric line to Nantasket Beach.

NORTH ADAMS, MASS.—The Hoosac Valley St. Ry. Co. is reported as proposing to extend its electric line through Greylock and Blackington.

MILFORD, CONN.—J. D. Brown and others have petitioned the legislature for a charter for an electric railway to Bridgeport and Woodstock.

NEW BRITAIN, CONN.—The Central & Electric Ry. Co. has decided to extend its line to Hartford and Berlin, bids for the construction of which have been received.

ROCKVILLE, CONN.—The Rockville & Ellington St. Ry. Co. has completed a survey for a road through Vernon Center, Dobsonville and Phoenixville and will present it at a town meeting to be held Nov. 9. The survey is from Snipsic dam to the Saxony mill and from there up West St. to Vernon Center.

BALLSTON SPA, N. Y.—F. B. Barnes, representing the Boston Construction Co., has been granted a franchise for an electric railway from Ballston to the village line. The road is to be in operation Aug. 1. This is the first step toward a network of electric roads in Saratoga county. The most important connection will be that of Ballston Spa and Saratoga Springs, which are seven miles apart.

BROOKLYN, N. Y.—The Brooklyn City R. R. Co. and the Newtown R. R. Co. have been granted franchises to extend their electric lines to Flushing.—It is reported that Flushing & College Point Electric R. R. Co. proposes to extend its line.

COHOES, N. Y.—The Cohoes City Ry. Co. has accepted the franchise granted by the council.

ORISKANY, N. Y.—The construction of a street railway between this village and Whitesboro, at an estimated cost of $3,000 to $3,500, is being discussed. J. W. Boyle, Pres., Utica Belt Line St. Ry. Co., has been consulted on the subject.

FRANKLIN, N. J.—The Passaic & Newark Electric R. R. Co. will soon construct its line. Pres., B. W. Spencer.

RUTHERFORD, N. J.—The Union Traction Co. has been incorporated with a capital stock of $1,500,000; incorporators, G. S. Forbush, Brookline, Mass.; F. J. Cullamen, E. T. Galloway, Rutherford; H. C. Broking, Carlstadt; L. H. Levin, New York.

ALLENTOWN, PA.—Press reports state that the Allentown & Lehigh Valley Traction Co. will vote on an increase of the capital stock, from $1,500,000 to $4,000,000, to build extensions.

BOYLESTOWN, PA.—The Delaware & Schuylkill Traction Co. has been incorporated with a capital stock of $50,000; incorporators, Francis Fenimore, Pres., St. Davids; W. J. Fell, Faulkland, Del.; M. S. Lynch and R. C. Fulton, Philadelphia.

PHILADELPHIA, PA.—The Columbia, Ironville & Mount Joy St. Ry. Co. has been incorporated with a capital stock of $300,000; Pres., O. E. McClellan.

PITTSBURG, PA.—The Pittsburg & Arlington Ave. St. Electric Ry. Co. has been incorporated with a capita stock of $21,000; Pres., John Murphy.

ST. DAVIDS, PA.—The United Traction Co. of Pennsylvania has been incorporated; capital stock, $100,000; Pres., W. A. Barritt, Jr.

BALTIMORE, MD.—Efforts are being made to construct a chain of electric railways to connect this city with Gettysburg. According to press reports the Elkins-Widener traction syndicate is backing up the enterprise, and it is stated that there is also a plan under consideration for the construction of trolley lines from Philadelphia to Gettysburg. The distance from Baltimore to Gettysburg by the route laid out is 50 miles, as against 72 miles by steam railway. The parts of the line to be provided by different companies are: Pimlico & Pikesville Ry., seven miles; the Pikesville, Reisterstown & Emory Grove Ry., nine miles; Westminster & Union Mills Ry., 17 miles; Gettysburg Electric Ry., 17 miles from Union Mills, through Littlestown, Pa., to Gettysburg. The traction syndicate controls the lines going out of Baltimore in that direction.

HENDERSON, MD.—The Henderson Electric St. Ry. Co. has been reorganized with the following officers: Pres., W. E. Whitney; Secy., J. N. Alsop; David Banks, Reuben A. Miller and Elijah Sebree. The company expects to lay three miles of new track by next March and another mile by August. The cost of the improvements that are to be made will be $45,000. Six closed, two double motor cars and nine trailers will be used. The location of the power-house has not yet been decided on.

CEDARTOWN, GA.—A franchise has been granted to members of the Cedartown Improvement Co. for an electric railway. Gen. Man., Charles Adamson.

NEW ORLEANS, LA.—The New Orleans Traction Co. is reported about to construct an electric power station to cost, fully equipped, about $250,000.

BEREA, O.—The Cleveland & Elyria Electric R. R. Co. has been incorporated with a capital stock of $200,000; incorporators, F. T. Pomeroy, M. A. Sprague, A. W. Bishop.

MOUNT VERNON, O.—The Mount Vernon & Walhonding Electric Ry. Co. has been incorporated with a capital stock of $50,000; F. T. Bolgun, W. F. Bullinger, A. D. Bunn and D. B. Kirk.

WINTON PLACE, O.—Bids are asked until Nov. 20 for constructing and operating an electric railway. R. B. Poage, Village Clk.

SAGINAW, MICH.—The Saginaw Consolidated St. Ry. Co. has been incorporated with a capital stock of $150,000; incorporators, W. H. Stevens, F. E. Snow and David Wallace.

BLOOMINGTON, ILL.—W. A. Patterson has purchased the Lincoln Electric St. Ry. for $75,000. Improvements and extensions are to be made at once.

CHICAGO, ILL.—The Cook County Electric Ry., Light & Power Co. has been incorporated with a capital stock of $500,000; incorporators, C. N. Durand, A. T. Young and Chas. Greenwood.

GALENA, MO.—The council is considering granting a franchise to G. B. Paxson for an electric railway.

ST. LOUIS, MO.—The Southwestern St. Ry. Co. is about to petition the assembly for a franchise. Pres., George Fox; Secy., A. E. Weiss; Treas., J. M. Wiener.

LOS ANGELES, CAL.—Press reports state that Prof. T. S. C. C. Lowe, builder of Pasadena's Mountain Ry., has made a contract whereby the mountain railway will be extended from Echo Mountain, its present terminus, to the highest summit of Mount Lowe. The extension will be an electric road and will be seven miles in length.

HAMILTON, ONT.—Press reports state that W. F. Forsyth, Boston, Man. Hamilton Radial Ry. Co., has contracted for the purchase of the Niagara Central Ry., running from Niagara Falls to St. Catherines. The purchase price is over $400,000 for the 13 miles of road, which will be extended to Hamilton to make connection with the Radial Co.'s lines. It is the intention of the syndicate to construct electric railways to Fegus, Guelph, Brantford and Woodstock.

HIGHWAYS.

OHIO.—The following bids have been received by the commissioners of Hamilton county, Cincinnati, for improving Carthage Pike: William Fogarty (awarded contract), $12,028; N. Reubel & Bros., $14,342; Ryan & Link, $14,355; Henkle & Sullivan, $14,475; P. Gleason & Sons, $14,670; Byrnes & Drach, $15,360; Ruffner Bros., $15,455; B. Auer, $15,610; G. Schmidt, $16,280; Kirchner & Folz, $17,110; Doerch & Willen, $17,315; H. Dickmeier, $17,815; J. McDermott, $18,785; James Agnes, $19,585; engineer's estimate, $18,700.

MISSOURI.—The court of Jackson county, at Kansas City, has awarded contracts for macadamizing as follows: Woodland road, John Mahoney, $1,475; Lexington road, T. F. Ryan, $4,216; Blue Springs road, Colyer Bros., $6,034.

BRIDGES.

LAWRENCEVILLE, PA.—The county commissioners are reported as to construct a new iron bridge in place of the old Baldwin bridge above this place, which has been condemned.

NATCHEZ, MISS.—Bids will soon be asked by the supervisors of Adams county for a 158-ft. bridge across the Homochetts River, for which plans are being prepared. Oliver N. Wilds, Pres.

NEW ORLEANS, LA.—The city engineer has completed plans for an iron bridge across the canal at Galvez St. It will be a swing bridge, giving an opening of 50 ft., according to reports.

DAYTON, O.—The contract for the Warren St. hoist bridge has been awarded to the King Bridge Co., at $11,796. The bids were published last week. F. M. Turner, Cy. Engr.

RICHMOND, IND.—It is reported probable that a contract for a $70,000 bridge will soon be awarded.

MARINETTE, WIS.—A new iron bridge will be built across the Menominee River this winter, according to reports.

PRAIRIE DU CHIEN, WIS.—The Chicago, Milwaukee & St. Paul Ry. Co. is reported about to build a single-span railway drawbridge across the Mississippi River at this place. It is reported that the plans for the bridge have been approved by the secretary of war.

FRANKLIN, NEB.—Bids are asked until Dec. 17, according to reports, for a 72-ft. wooden bridge. G. Hanson, County Clk.

LINCOLN, NEB.—The citizens voted this week on an issue of $144,000 in bonds for a viaduct on Ninth St., from U to Y streets. The plans have been prepared by Adna Dobson, Cy. Engr.

KANSAS CITY, MO.—Bids are asked until Nov. 23 for the construction of four wooden bridges. Frank J. O'Flaherty, County Surv.

TACOMA, WASH.—Bids are asked until Nov. 17 for the construction of a combination iron and wood bridge across the Puyallup River. A. V. Fawcett, Chn. Comrs.

MONTREAL, QUE.—Bids are asked until Nov. 21 for the steel superstructure and trestle bents for bridge over the Canadian Pacific Ry. tracks on Notre Dame St. Percival W. St. George, Cy. Surv.

WATER-WORKS.

JOHNSON, VT.—The village is taking steps to put in works estimated to cost $2,200. A water power pump and about a mile of mains will be required. B. L. Austin is town clerk.

BROCKTON, MASS.—The city engineer has prepared plans for a high-pressure service for Brockton Heights and Cary Hill, at an estimated cost of $142,000.

MILLIS, MASS.—At a town meeting Oct. 29 it was voted to purchase the electric light plant and the water-works.

MILLBURY, MASS.—The contract for building the receiving well for the new works has been awarded by the Worcester Engineering Co. to Timothy F. Lyon, Providence, R. I.

SOUTHAMPTON, MASS.—F. E. Judd, Town Clk., writes us that surveys have been made for new works with supply from mountain streams, and that the question of construction will come before the town meeting March 17.

SPENCER, MASS.—The "Leader" states that the estimated cost of bringing a supply to the village from the proposed pumping station at Quacumquasit is $17,000.—A. W. Curtis, Town Clk., writes us that there is talk of a stand-pipe.

SUTTON, MASS.—The selectmen have contracted with Geo. Tyler & Co., for a windmill or engine over

the well at Sutton Center and a 5,000-gallon tank to supply water for town hall, school houses, etc.

DURHAM CENTER, CONN.—It is reported that a supply will be secured from springs and pumped by windmill to a large receiving tank, from which pipes will be laid through the village.

JEWETT CITY, CONN.—New Haven parties are reported to have contracted to put in works, including a reservoir.

ANGELICA, N. Y.—The citizens have voted to put in works to cost $25,000, according to reports.

BUFFALO, N. Y.—Bids are asked until Nov. 14 for 600 or more iron hydrant covers and 100 extension cases; also for the erection of a one-story brick addition to the boiler house at the lower pumping station. R. G. Parsons, Secy. Dept. Pub. Wks.——The following bids were received for removing rock in Moselle St. for laying a 16-in. water pipe: Geo. W. Moore, $900 (awarded contract); John Mumm, $1,200; Aug. Gisel, $1,300; Geo. Dark and Thos. Dark, Jr., $1,300; A. R. Clark & Co., $1,320; Jacob Ritzmann, $1,350; Fred. J. Martin, $1,600; John Harrer, $1,650.

CANANDAIGUA, N. Y.—Walter F. Randall, Syracuse, has prepared plans for new works, including 28 miles of mains, 204 hydrants, 205 gate valves, and estimated to cost $130,000.

FREDONIA, N. Y.—John Bogart has been engaged to report on plans for an increased supply. Engineer Wilder of this place has recommended that a reservoir be constructed at a cost of about $9,000.

JEFFERSONVILLE, N. Y.—The residents of this village are reported to have subscribed $1,000 for works. John H. Glassel, Secy. W. Co.

MIDDLEBURG, N. Y.—J. Warren Lamb, Engr., Cooperstown, N. Y., writes us that the Middleburg Water Co. has commenced the construction of its works. The plant requires four miles of 10 to 4-in. pipe and 30 hydrants. R. D. Wood & Co., and the Donaldson Iron Co. furnish the pipe, and the Eddy Valve Co. the valves and hydrants. The supply is from a mountain stream that carries at all times water enough for all requirements, without storage other than a distributing reservoir of 100,000-gallons capacity.

NEW YORK, N. Y.—Bids are asked by the department of public works until Nov. 20 for furnishing and laying mains from shaft No. 25, new aqueduct, to the pumping station at high bridge.

NORTH SYRACUSE, N. Y.—The citizens are trying to secure works, according to reports.

MORRIS, N. Y. Bids will soon be asked for the construction of works, for which the citizens have voted. J. Warren Lamb, Engr., Cooperstown, writes us that the plan adopted requires about 3½ miles of 8, 6 and 4-in. pipe, 28 hydrants and a 100,000-gallon distributing reservoir. The supply is from a mountain stream, that passes water enough at all times for consumption without storage.

ROCHESTER, N. Y.—The contract for the new gate house at Rush reservoir has been awarded to Whitmore, Rauber & Vicinus, at $3,250.

ROME, N. Y.—The city engineer is preparing plans for a new main to the county house. It is reported that bids for the construction will be asked so that the work can be commenced Nov. 20.

NYACK, N. Y. The Nyack Water-Works Co. is reported as negotiating with the New York Filter Co. for a filter.

ASBURY PARK, N. J.—The council has authorized a contract for another new well. A well 1,100 ft. deep has just been sunk.

NEWTON, N. J.—Bids are asked until Dec. 3 for the construction of works, as stated in our advertising columns. Ch. Engr., Louis L. Tribus, New York. Alex. Craig, Secy. Bd.

ALLEGHENY, PA.—Bids are asked by the director of public works until Nov. 28 for three 12,000,000-gallon pumping engines, to pump against a 300-ft. head.

GALETON, PA.—The Pike Mills Water Co. has been incorporated; capital stock, $5,000; Treas., Austin W. Clinton.

SCRANTON, PA.—The Cross Fork Water Co. has been incorporated by Jas. L. Connell, Scranton, to supply water to Stewardson, Potter county; capital stock, $7,500.

WAVERLY, PA.—Steps are being taken to organize a water company, supply to be pumped from springs to a reservoir.

DAWSON, GA.—A. J. Baldwin, Mayor, writes us that an election will be held Nov. 14 to vote on an issue of $35,000 in bonds to erect or purchase works and an electric light plant.

CUTHBERT, GA.—Robt. L. Moye, Mayor, writes us that M. F. Sullivan, of Mable & Sullivan, Atlanta, is making surveys for the proposed works and electric light plant, as stated in our issue of last week. Bids for the contract work will be asked for when specifications are completed. The city has issued $50,000 in bonds, and the $40,000 or $45,000 necessary to construct the plant will probably be sold at private sale this week or next.

PALM BEACH, FLA.—J. A. McGuire, of McGuire & McDonald, St. Augustine, is constructing works for H. M. Flagler at West Palm Beach. The works will also supply the Hotel Royal Poinciana across the lake and will cost at least $45,000, according to reports.

MARION, ALA.—Maj. Belton Mickle has been engaged to prepare specifications for works and it is reported that the plans were submitted to the council Oct. 25.

ATTICA, O.—Bids are asked until Nov. 13 for furnishing all material and constructing works. L. L. Sutton, Clk. Trustees.

BOND HILL, O.—The council is reported to have given up the idea of securing a supply from Cincinnati, and as taking steps to put in works with some other supply. The village voted $20,000 for works some time ago.

ELYRIA, O.—L. C. Kelsey, Clk., writes us that the works are owned by the Elyria Gas & Water Co. and that the city has not yet taken steps for a new and better supply, which is needed.

LANCASTER, O.—The following bids were received recently for extending the infiltration gallery: Stahl & Justus, $3.80 per ft., or $2,865; Louis Mayer, $4.12, or $3,090; F. C. Neeb, $4.75, or $3,562; Cowden & Cassell, $5.05, or $3,787.

NORWOOD, O.—The council has sold $25,000 of 5% water bonds.

TOLEDO, O.—The water board is reported as having decided to construct a new 30 or 36-in. main to cost at least $125,000.

CENTERVILLE, MICH.—E. L. Clapp, Clk., writes us that nothing definite has yet been done for works.

DECATUR, MICH.—An election will be held Nov. 15 to vote on an issue of $12,000 in bonds for works.

EATON RAPIDS, MICH.—At the election this week the citizens voted on a proposition to issue $35,000 in bonds for works and an electric light plant.

EMMET, MICH.—A press report states that works will soon be put in; population, 225.

SHELBY, MICH.—Plans for new works are being prepared by Geo. C. Morgan, Major Block, Chicago. A Downie pump will pump water from a deep well into a brick reservoir.

VEVAY, IND.—We are informed that the citizens have voted to construct works, but that no other steps have been taken except to appoint a committee consisting of James M. Scott, C. S. Sandy and J. P. Carter; supply from Ohio River; population, 1,700.

CARMI, ILL.—The construction of the new works was commenced Oct. 20. This will be completed about Dec. 20. Water will be pumped from the Little Wabash River to a 12 × 116-ft. stand-pipe. Geo. C. Morgan, Chicago, is the engineer and contractor.

LEXINGTON, ILL.—The new works will be completed about Dec. 1. Water is pumped from a well to a Morgan special tower. Engr., Geo. C. Morgan, Major Blk., Chicago.

VANDALIA, ILL.—The contract for works has been awarded to Newcomer & Hill, at $29,560. Engr., Hiram Phillips, St. Louis. The bids were published last week.

WINONA, ILL.—Geo. C. Morgan, Major Block, Chicago, is engineer for the new works. Water will be pumped from a deep well.

MAUSTON, WIS.—The citizens voted on the question of works Nov. 6.

TOMAH, WIS.—Construction of new works was commenced Oct. 15, and will be completed about Dec. 10. Water will be pumped from Spring Creek to a Morgan special tower, by two 1,500,000-gallon pumps. Engr., Geo. C. Morgan, Chicago.

WAUPUN, WIS.—The question of issuing $33,000 in bonds for works will be voted upon Nov. 13.

CASCADE, IA.—C. D. Baldwin, Recdr., writes us that M. Tschirgi, Jr., Dubuque, is preparing plans for works, which will include 6,500 ft. of 8 and 6-in. mains, 40,000-gallon reservoir, etc.——Bids are asked until Nov. 18 for constructing works, as stated in our advertising columns.

EAGLE GROVE, IA.—The contract for works has been awarded to B. Schriener, Des Moines.

GRUNDY CENTER, IA.—The village is putting in works consisting of a 12 × 100-ft. steel stand-pipe, two miles of 8 and 6-in. mains and a 40-HP. pumping station. Fremont Turner, Des Moines, is the contracting engineer.

HULL, IA.—N. G. O. Coad, Mayor, writes us in regard to the items in our last two issues that he was not aware that the committee would try to put in works this fall until bids were asked for the tower and tank, as noted last week, and he adds: The committee thinks it can build works without money and I do not, thus causing a difference between us.

MINNEAPOLIS, MINN.—The council has engaged J. T. Fanning to examine the plans of the city engineer for a new reservoir estimated to cost $1,146,000.

PRESTON, MINN.—Wm. J. Hey, Recdr., writes us that at the election Sept. 14 the water-works proposition was defeated by 16 votes.

WELLS, MINN.—The contract for works has been awarded to O. H. Olson & Co., Stillwater, at $15,225.

SENECA, KAN.—D. W. Acker, Cy. Clk., writes us that the question of issuing bonds for works will be voted upon Nov. 15.

DESHLER, NEB.—It is stated that steps are being taken to put in works. Address Chas. G. Low, Secy. Deshler Improvement Co.

NELSON, NEB.—The citizens have voted to issue $13,000 in bonds for works.

CASPER, WYO.—W. S. Irwin, Town Clk., writes us that the $30,000 in bonds have not yet been sold and no bids have yet been asked for works. The supply will be by gravity from springs in the mountains 5½ miles distant and the plant will include a reservoir, filter, meters, water wheel for running electric light plant, and will probably cost about $25,000. Engr., Chas. H. Rogers, Denver, Colo.

SALISBURY, MO.—Bids are asked until Nov. 26 for the construction of works, for which bonds were recently voted.

SPRINGFIELD, MO.—The water company is reported about to secure a new supply, at a cost of $15,000.

FORT WORTH, TEX.—The council has voted to construct three dams in the Clear Fork, at a cost of $5,000 each. Efforts are being made to secure an issue of $150,000 in bonds for extensions and improvements, as noted last week.

FLORENCE, COLO.—Robt. A. Rutledge, Cy. Engr., writes us that at an election Oct. 27 the citizens granted a franchise for works to Wm. E. Johnston, Pres. Florence & Cripple Creek R. R. Co., but that no definite plans have yet been decided upon; supply from wells; population, 2,000.

GRAND JUNCTION, COLO.—S. G. McMullin, Cy. Clk., writes us that a preliminary survey has been made to ascertain the feasibility of a supply from mountain lakes 26 miles distant and that a special election will probably be held soon to vote on an issue of $200,000 to $300,000 in bonds for complete new works, as the present works are owned by a company and the service is unsatisfactory; population, 4,000.

McMINNVILLE, ORE.—The council is reported to have decided to construct a system of wells in the spring. The present supply is from the river.

TACOMA, WASH.—The board of public works is considering the proposed construction of about a mile of 30-in. pipe.

PORT HOPE, ONT.—It is reported that the council has advertised for bids for plans for works and that the only bid received was that of McQuillan & Co., Toronto.

PICTOU, N. S.—F. Mackaracher, Town Clk., writes us that the estimated cost of proposed gravity system from brook five miles distant is $112,000, which the town considers too high, and that it is now proposed to bore an 8-in. well to see if a supply cannot be secured in that way.

IRRIGATION.

PRESCOTT, ARIZ.—It is reported that plans have been completed for the construction of an irrigation dam near this city to cost $120,000. Address S. J. Hartman.

SEWERS.

PORTLAND, ME.—A better method of disposing of the sewage now discharged into the bay is under consideration. Consult. Engr., Rudolph Hering, New York.

MARLBORO, MASS.—The committee has recommended the construction of sewers, with the intermittent filtration system of sewage disposal; estimated cost, $146,000.

BROOKLYN, N. Y.—The commissioner of city works has been authorized to readvertise for bids for four contracts for building pipe sewers in Ward 26.

BUFFALO, N. Y.—Bids are asked until Nov. 14 for constructing 12-in. pipe sewers in two streets. R. G. Parsons, Secy. Dept. Pub. Wks.

DEPEW, N. Y.—The trustees are obtaining permission to construct sewers in several streets of the village.

SYRACUSE, N. Y.—The city clerk has been directed to advertise for bids for constructing 18 to 12-in. pipe sewers in six streets.——The city engineer estimates the cost of constructing 18-in. pipe sewers in three streets at $4,920.

WHITE PLAINS, N. Y.—The trustees have directed the village engineer to prepare plans for constructing a sewer the entire length of Mamaroneck Ave., and bids will soon be asked for the construction.

MONTCLAIR, N. J.—Bids are asked until Nov. 19 for constructing 3,779 ft. of 8-in. pipe sewers; four contracts. H. Trippett, Town Clk.

WOODBRIDGE, N. J.—Bids are asked by the Woodbridge Sewerage Co. until Nov. 12 for constructing 2,500 ft. of 6 and 8-in. pipe sewers in two streets.

READING, PA.—The Pennsylvania Sanitary Sewage Co. has been awarded a contract for a sewage disposal plant of 5,000,000 gallons capacity at about $80,000. The bids were published Feb. 8 under Contract Prices, but no appropriation for the work was made at that time.

TUNKHANNOCK, PA.—Joseph Wood Pialt, Clk., writes us that the council is considering using the funds intended for an electric light plant to construct a sewerage system. The council does not seem to have been able to take the matter up in the right manner, and is now waiting for some one who will give estimates, etc. C. O. Dersheimer, Pres. of Council.

PORTSMOUTH, VA.—Bids are asked until Nov. 20 for constructing sewers, as stated in our advertising columns. The bids for this work were published July 19 under Contract Prices. E. Thompson, Jr., Clk. of Council; Engr., W. T. Brooke, Norfolk.

BRUNSWICK, GA.—The council has voted to use iron pipe for the 24 to 15-in. pipe sewers, at an estimated additional cost of about $4,000.

WASHINGTON, D. C.—The commissioners have ordered the construction of sewers in 14 streets at an estimated cost of about $36,000.

BOWLING GREEN, O.—The committee has recommended the construction of a system and that an engineer be engaged to make surveys.

SHARON, O.—It is reported that plans have been made for a system.

TOLEDO, O.—Bids are asked until Nov. 12 for constructing 24 and 20-in. brick sewers in four streets. L. P. Harris, Cy. Clk.

LAFAYETTE, IND.—Bids are asked until Nov. 12 for constructing sewers in two streets. T. W. Burt, Cy. Clk.

CHICAGO, ILL.—Bids are asked until Nov. 13 for constructing sewers in 11 streets. H. J. Jones, Comr. Pub. Wks.

CHICAGO HEIGHTS, ILL.—Bids are asked until Nov. 12 for constructing a sewer on Vincennes Ave. Plans and specifications can be seen at the office of W. B. Ewing, Village Engr., Chamber of Commerce Bldg., Chicago, Ill., or at the office of the village clerk.

MENDOTA, ILL.—It is reported that this place will put in a system that will cost $78,000.

MENDOTA, ILL.—The construction of a system estimated to cost about $78,000 is being discussed, according to reports.

OCONOMOWOC, WIS.—An engineer is to be engaged to make surveys and estimates for a system. J. A. Peacock, Chn. St. Com.

RIPON, WIS.—The contract for constructing 20,000 ft. of pipe and 1,100 ft. of brick sewers has been awarded to A. J. Perry & Co., Bay City, Mich., at about $20,000.

KEOKUK, IA.—The boards of education and health are discussing the question of petitioning the council to extend the main sewer at an estimated cost of about $32,000.

LITTLE ROCK, ARK.—Bids are asked until Nov. 13 for constructing a system at the new military post near this city. Capt. R. R. Stevens.

GALT, ONT.—The construction of a sewerage system is reported as being agitated.

STREETS.

BOSTON, MASS.—Bids are asked until Nov. 12 for 75,000 cu. yds. of filling in Boylston St. H. H. Carter, Supt. St. Dept.

DEPEW, N. Y.—There is a possibility that several of the streets will soon be paved.

NEW YORK, N. Y.—Bids are asked by the department of public works until Nov. 20 for paving portions of four streets with granite blocks, and one street with asphalt on the present stone block pavement.

SYRACUSE, N. Y.—Bids have been received for paving Liberty St. with Trinidad asphalt from the Warren-Scharf Asphalt Paving Co. at $6,422, and the Syracuse Improvement Co. at $5,852. The following bids were received for doing the work with brick: A. F. West, $5,170; Homer & Co., $5,195; G. D. Grannis, $5,168; L. D. Hulbert, $4,716.

WASHINGTON, D. C.—Bids are asked until Nov. 13 for constructing brick, asphalt, tile or asphalt block sidewalks. Address the district commissioners.

CLEVELAND, O.—Bids are asked until Nov. 14 for grading and constructing the Doan Brook boulevard between St. Clair St. and Wade Park Ave. J. H. Farley, Dir. Pub. Wks.

FINDLAY, O.—The Peerless Construction & Paving Co. has been incorporated with a capital stock of $50,000; incorporators, W. V. Coons, G. H. Phelps, T. H. McConica and D. T. Davis.

FOSTORIA, O.—Bids are asked until Nov. 14 for certain paving.

MADISONVILLE, O.—Bids are asked until Nov. 12 for constructing about 3,510 lin. ft. of cement sidewalk in Michigan Ave. E. C. Fowble, Clk.

NORWOOD, O.—Bids are asked until Nov. 17 for macadamizing Sherman Ave.

TIFFIN, O. The contract for paving Jefferson St. has been awarded to Cuthbert & Stewart at $29,135.

TOLEDO, O.—The following bids have been received for paving St. Clair St.: H. P. Streicher, Medina stone, $11,979; cedar blocks, $6,898; vitrified brick, $7,311; Mack block, Massillon block, Harris block, Harris paver, plain Hallwood, brown granite and blue granite, $8,167; asphalt, $17,315. T. B. Townsend Co. bid $8,059 for Hallwood blocks.

EAST ST. LOUIS, ILL.—The council has directed that bids be asked for reconstructing Eighth St. and paving it with brick, at an estimated cost of $103,000, according to reports.

QUINCY, ILL.—The ordinance committee has recommended the paving of about two miles of streets, in addition to that already ordered. It is probable that next year the committee will recommend the paving of about four miles additional.

MUNCIE, IND.—Bids are asked until Nov. 12 for paving several sidewalks with brick.

MILWAUKEE, WIS.—The National Sidewalk & Paving Co. has been incorporated with a capital stock of $10,000; incorporators, Geo. Zimmerman, A. S. Austin and J. B. Whitnall.

SEATTLE, WASH.—The contract for grading Kilbourne Ave. and George St. has been awarded to James Spurr, at $16,686, the other bidders being J. A. Bailey, $18,496, and D. V. McDonald, $21,361.

ELECTRIC LIGHT AND POWER.

JOHNSON, VT.—The village is taking steps to put in an electric light plant for street lighting. About 40 lamps of 25 c. p. will be required and no contracts have yet been awarded. Address B. L. Austin, Town Clk.

NORWALK, CONN.—The South Norwalk & Norwalk Electric Co. has offered its plant to the city at its original cost of about $125,000. This is done for the reason that the city proposes establishing a commercial plant.

LYNCHBURG, VA.—M. W. Thomas, representing the Old Dominion Electrical Construction Co., Richmond, has made estimates for a municipal electric light plant.

RICHMOND, VA.—The committee has engaged M. W. Thomas to make estimates for a municipal electric light plant.

DAYTONA, FLA.—It is reported that a company will be incorporated to establish an electric plant for lighting and street railway purposes.

EAST LIVERPOOL, O.—The electric light plant was destroyed by fire Oct. 31, only the boilers and engines being saved; loss, $12,000 to $15,000.

BREMEN, IND.—It is reported that $48,000 has been subscribed for an electric light plant to be put in at once.

BURLINGAME, KAN.—It is reported that this place is to have electric lights.

BUNKER HILL, MO.—Plans for an electric light plant will soon be prepared, according to reports.

PLATTSBURG, MO.—It is stated that the citizens are discussing the question of electric lights.

ROGERS, ARK.—The council is reported as figuring on an $8,000 electric light plant.

NEW COMPANIES.—Marble City Water & Power Co., Marble City, Colo.; $100,000; R. H. Kline, Philadelphia, Pa.; W. W. Wood, A. J. Mitchell, Marble City.—Chappaqua Electric Light & Power Co., Chappaqua, N. Y.; $30,000; to light New Castle, Bedford and Mount Pleasant; F. B. Selleck, B. G. Selleck, New York; J. S. Quinby, Chappaqua.—Michigan Lighting Co., West Bay City, Mich.; $10,000; F. H. Mohr.—Eureka Electric Mfg. Co., St. Louis, Mo.; $30,000; Alfred Bevis, C. H. Longstreet, D. Smith.—National Electrical Reminder Co., Chicago, Ill.; $250,000; to manufacture electrical devices and merchandise; Siegfried Rosenfield, Augustus Binswanger, D. C. Thomas.—Le Bel Electric Co., Portland, Me.; to manufacture materials for kindling fires; Pres., E. D. Freeman, Yarmouth; Treas., George Hall, Ogdensburg, N. Y.—Rae Electric Mfg. Co., Detroit, Mich.; Pres., F. B. Rae; Secy., F. H. Date; Treas., B. H. Scranton.—Grand Island Land Co., Buffalo, N. Y.; $20,000; J. L. Van Buren, J. C. Baker, Dunkirk; C. W. Holland, Buffalo.—Paragould Electric Light Co., Paragould, Ark.; $5,500; T. H. Wyse, D. A. Bertig, T. B. Kitchens.—Power Development Co., San Francisco, Cal.; $500,000; to furnish electric power, erect water-works and electric light and power plants; Albert Miller, E. W. Hopkins, C. W. Howard, San Francisco; C. W. Beal, New York, N. Y.—Hunterdon Electric Co., Lambertville, N. J.; $30,000; W. B. Bratten, Lenni, Pa.; W. A. Robinson, G. W. Jacobs, Philadelphia; A. V. Robinson, Trenton.—Cook County Electric Ry., Light & Power Co., Chicago, Ill.; $500,000; C. N. Durand, A. T. Young, Charles Greenwood.—Wilder-Sloss Electric Hotel-Call Co., Chicago, Ill.; $250,000; Louis Stein, E. R. Wilder.—London Electric Co. (Limited), London, Ont.; $250,000; H. P. Dwight, Frederick Nicholls, Hugh Ryan, Toronto; M. J. Kent, London.—Mother Lode Power Co., San Francisco, Cal.; $800,000; C. W. Randall, Alameda; J. F. Parks, Jackson; John Martin, Berkeley; C. D. Pierce, Oakland.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

LEVEE REVETMENTS.—New Orleans, La.—Bids are asked until Nov. 12 for constructing wooden levee revetments. Capt. John Millis, U. S. Engr. Office.

PIER.—Ottawa, Ont.—Bids are asked until Dec. 3 for the construction of a pier at Thessalon, Algoma county. E. F. E. Roy, Secy. Dept. Pub. Wks.

LEVEE WORK.—Shreveport, La.—Bids are asked until Nov. 13 for the construction of about 128,000 cu. yds. of levee work. W. J. Crowder, Pres. Comrs. Caddo Levee District.

BREAKWATER EXTENSION.—Buffalo, N. Y.—Bids are asked until Dec. 10 for extension of breakwater at Dunkirk Harbor, as stated in our advertising columns. Maj. E. H. Ruffner, U. S. Engr. Office.

CRUSHED STONE.—Baltimore, Md.—Bids are asked until Nov. 12 for furnishing and delivering 223 cu. yds. of crushed stone at Hog Island Light Station, Va. Capt. Eric Bergland, U. S. Lighthouse Engr.

FOUNDATIONS FOR BUILDING.—Atlanta, Ga.—Bids are asked until Nov. 12 for furnishing the material and laying the foundation for the agricultural, electricity and forestry buildings at Piedmont Park. Grant Wilkins, Ch. of Construction.

DREDGING. Galveston, Tex.—Bids are asked until Nov. 27 for dredging and removing obstructions in Buffalo Bayou, Tex., dredging ship channel in Galveston Bay, and dredging in West Galveston Bay. Maj. A. M. Miller, U. S. Engr. Office.

INTERIOR BUILDING WORK.—St. Albans, Vt.—Bids are asked until Nov. 30 for the interior finish, plumbing and approaches for the U. S. public building at this place, as stated in our advertising columns. Address Chas. E. Kemper, Acting Supervising Arch., Treasury Department, Washington, D. C.

COTTON MILL.—Pelzer, S. C.—James Stewart & Co., St. Louis, have been awarded the contract for constructing the Pelzer Mill at this place. The building will be 600 × 150 ft., heaviest type of mill construction, and the construction will require over 2,500,000 ft. of timber. Water-power will be used in the mill.

JETTY WORK.—Sabine Pass, Tex.—The following bids were received by Maj. James S. Quinn, U. S. Engineer Office, New Orleans, Oct. 29, for jetty extension at harbor at Sabine Pass, Tex.: F. A. Hyatt & Co., Beaumont, Tex., $115,250; Charles Clarke & Co., Galveston, Tex., $127,827; John A. Davis, Galveston, Tex., $154,162; Roderich G. Ross, Jacksonville, Fla., $146,837.

PIER WORK.—Duluth, Minn.—The following bids were received by Maj. C. B. Sears, U. S. Engineer Office, Oct. 20, for repair work to piers at upper entrance, Portage Lake Ship Canals: Campbell & McDonald, Duluth, $11,292; James E. Smith, Marquette, Mich., $14,403; Daniel W. Powell, John Mitchell & Edward Mitchell, Marquette, $11,217; A. & D. Sang, Duluth, $8,435.

SEA WALL.—Baltimore, Md.—The following bids were received by Col. W. P. Craighill, U. S. Engineer Office, Oct. 20, for building a sea wall at Fort McHenry: Jas. P. McGovern, Baltimore, $2,714; Owen Patterson, Baltimore, $3,526; Wm. H. Morrow, Baltimore, $4,878; A. Weber & Co., Baltimore, $2,866; Jones, Pollard & Co., Baltimore, $2,461; A. J. McFrederick, Baltimore, $3,542; Geo. F. Nardin, McDonogh, Md., $2,356.

MODEL BARGES.—St. Louis, Mo.—Thme following bids were received by Maj. Chas. J. Allen, U. S. Engineer Office, Oct. 24, for 12 model barges: Geo. T. Nelles & Co., Leavenworth, Kan., 12 barges at $3,540 each; Interstate Lumber Co., Chattanooga, Tenn., 12 at $3,385 each; Cincinnati Marine Ry. Co., Cincinnati, O., 12 at $3,584 each; Louis H. Skinner, Wilmington, N. C., 12 at $4,041 each; Ed. J. Howard, Jeffersonville, Ind., 4 or 6 at $3,600 each; David S. Barmore, Madison, Ind., 8 at $3,590 each.

RIVER STRAIGHTENING.—Sioux City, Ia.—It is reported that the council plans to furnish work for all who become dependent on charity this winter by putting them to work on the straightening of the Floyd River. The stream overflowed its banks two years ago, and lives and property were lost. The danger can be averted if the stream is straightened, which has not been done because of the expense. The new plan would secure an improvement that would otherwise cost $100,000.

CANAL IMPROVEMENTS.—Albany, N.Y.—Additional contracts for state canal work have been awarded as follows: For the construction of a stone dam across the Oswego River at Oswego to James B. Donnelly, Buffalo, at $23,208; improving 5,200 lin. ft. of the Champlain Canal at Bemis Heights, to the Troy Public Works Co., Troy, at $35,385; constructing two iron bridge superstructures and one iron bridge at bridge stations No. 39 and 40 of the Champlain Canal, to the Hilton Bridge Co., Albany, at $1,450.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
Nov. 9.	Dredging.	Wilmington, Del.	Oct. 11
	Advertised, Eng. News, Oct. 11 to Nov. 1.		
Nov. 9.	Furnishing dredge.	New Orleans, La.	Oct. 18
Nov. 9.	Grading, etc.,	Hamilton, O.	Oct. 18
Nov. 9.	Iron bridge,	New Orleans, La.	Oct. 25
Nov. 9.	Street improvements.	Avondale, O.	Oct. 25
Nov. 9.	Stand-pipe,	St. Charles, Mo.	Oct. 25
	Advertised, Eng. News, Oct. 25 and Nov. 1.		
Nov. 9.	Laying water pipe,	Rochester, N. Y.	Nov. 1
	Advertised, Eng. News, Nov. 1.		
Nov. 9.	Sewers,	St. Louis, Mo.	Nov. 1
Nov. 10.	Granite blocks (100,000),	Bangor, Me.	Oct. 25
Nov. 10.	Naval supplies,	Washington, D. C.	Oct. 25
Nov. 10.	Water-works system,	Rossville, Ill.	Oct. 25
Nov. 10.	Pier work,	Duluth, Minn.	Oct. 25
Nov. 10.	Supplies at New York navy yard,		Nov. 1
Nov. 10.	Supplies at Norfolk navy yard,		Nov. 1
Nov. 10.	Road building,	Missoula, Mont.	Nov. 1
Nov. 10.	Macadamizing,	Tiffin, O.	Nov. 1
Nov. 10.	Pipe sewers,	Fort Dodge, Ia.	Nov. 1
Nov. 11.	Pumping engines,	Chicago, Ill.	Oct. 18
	Advertised, Eng. News, Sept. 13 to 27.		
Nov. 12.	Pipe sewer,	Huntington, Ind.	Oct. 25
Nov. 12.	Artesian wells,	Wichita, Kan.	Oct. 25
Nov. 12.	Dredging,	San Francisco, Cal.	Oct. 25
Nov. 12.	Air pump and jet condenser,	Cleveland.	Nov. 1
Nov. 12.	Pipe sewers,	South Bend, Ind.	Nov. 1
Nov. 12.	Sidewalks,	Houston, Tex.	Nov. 1
Nov. 12.	Filling (75,000 cu. yds.),	Boston, Mass.	Nov. 8
Nov. 12.	Crushed stone (223 cu. yds.),	Baltimore.	Nov. 8
Nov. 12.	Foundations for buildings,	Atlanta, Ga.	Nov. 8
Nov. 12.	Cement sidewalks,	Madisonville, O.	Nov. 8
Nov. 12.	Brick sewers,	Toledo, O.	Nov. 8
Nov. 12.	Levee revetments,	New Orleans, La.	Nov. 8
Nov. 12.	Pipe sewers (2,500 ft.),	Woodbridge, N.J.	Nov. 8
Nov. 12.	Sewers,	Lafayette, Ind.	Nov. 8
Nov. 12.	Sewers,	Chicago Heights, Ill.	Nov. 8
Nov. 12.	Brick sidewalks,	Muncie, Ind.	Nov. 8
Nov. 13.	Heatg & vent'g ap.,etc.,	Sioux Falls, S. D.	Oct. 18
	Advertised, Eng. News, Oct. 18 and 25.		
Nov. 13.	Sewers,	Chicago, Ill.	Nov. 8
Nov. 13.	Sidewalks,	Washington, D. C.	Nov. 8
Nov. 13.	Water-works system,	Attica, O.	Nov. 8
Nov. 13.	Levee work,	Shreveport, La.	Nov. 8
Nov. 13.	Sewers,	Little Rock, Ark.	Nov. 8
Nov. 14.	Dredging,	Charleston, S. C.	Oct. 18
	Advertised, Eng. News, Oct. 18 to Nov. 8.		
Nov. 14.	Revetting banks,	Charleston, S. C.	Oct. 18
	Advertised, Eng. News, Oct. 18 to Nov. 8.		
Nov. 14.	Pipe sewers,	Buffalo, N. Y.	Nov. 8
Nov. 14.	Hydrant covers, etc.,	Buffalo, N. Y.	Nov. 8
Nov. 14.	Grading, etc.,	Cleveland, O.	Nov. 8
Nov. 14.	Paving,	Fostoria, O.	Nov. 8
Nov. 14.	Boiler house extension,	Buffalo, N.Y.	Nov. 8
Nov. 15.	Decked barges,	New Orleans, La.	Oct. 25
Nov. 15.	Water-works system,	Union City, O.	Oct. 25
Nov. 15.	Pier work,	New York, N. Y.	Nov. 1
Nov. 15.	Sewer pipe,	Arlington Heights, O.	Nov. 1
Nov. 15.	Water tower and tank,	Hull, Ia.	Nov. 1
Nov. 16.	Levee work (495,000 cu.yds),	Memphis.	Nov. 1
Nov. 17.	Canal work,	Ottawa, Ont.	Nov. 1
Nov. 17.	Bridge,	Tacoma, Wash.	Nov. 8
Nov. 17.	Macadamizing,	Norwood, O.	Nov. 8
Nov. 18.	Water-works system,	Cascade, Ia.	Nov. 8
	Advertised, Eng. News, Nov. 8.		
Nov. 19.	Stone,	Philadelphia, Pa.	Oct. 25
	Advertised, Eng. News, Oct. 25 to Nov. 15.		
Nov. 19.	Water extensions,	Johnstown, N. Y.	Nov. 1
Nov. 19.	Pipe sewers (3,779 ft.),	Montclair, N. J.	Nov. 8
Nov. 20.	Dredging,	Philadelphia, Pa.	Nov. 1
Nov. 20.	Asphalt paving,	Terre Haute, Ind.	Nov. 1
Nov. 20.	Asphalt paving,	New York.	Nov. 8
Nov. 20.	Sewers,	Portsmouth, Va.	Nov. 8
	Advertised, Eng. News, Nov. 8 and 15.		
Nov. 20.	Granite paving,	New York, N. Y.	Nov. 8
Nov. 20.	Laying water main,	New York	Nov. 8
Nov. 20.	Electric railway,	Winton Place, O.	Nov. 8
Nov. 21.	Paving,	Dayton, O.	Nov. 1
Nov. 21.	Bridge superstructure,	Montreal, Que.	Nov. 8
Nov. 22.	Electric light plant,	Dayton, O.	Oct. 25
Nov. 23.	Pipe sewers (10,000 ft.),	Warren, O.	Nov. 1
Nov. 23.	River improvement,	Ottawa, Ontario.	Nov. 1
Nov. 23.	Wooden bridges (4),	Kansas City, Mo.	Nov. 8
Nov. 24.	Elec. r'y sale,	N. Westminster, B.C.	Nov. 1
Nov. 26.	Water supply,	Monroe, Mich.	Nov. 1
Nov. 26.	Bridge,	Houston, Tex.	Nov. 1
Nov. 26.	Water-works system,	Salisbury, Mo.	Nov. 8
Nov. 27.	Public Building at Camden,	Ark.	Nov. 1
	Advertised, Eng. News, Nov. 1 and 8.		
Nov. 27.	Dredging (3 contracts),	Galveston, Tex.	Nov. 8
Nov. 28.	Pumping engines,	Allegheny, Pa.	Nov. 8
Nov. 30.	Interior bldg. work at,	St. Albans, Vt.	Nov. 8
	Advertised, Eng. News, Nov. 8 and 15.		
Dec. 1.	Electric lighting,	Ann Arbor, Mich.	Oct. 11
Dec. 3.	Water-works system,	Newton, N. J.	Nov. 8
	Advertised, Eng. News, Nov. 8 and 15.		
Dec. 3.	Pier,	Ottawa, Ont.	Nov. 8
Dec. 10.	Breakwater extension,	Buffalo, N. Y.	Nov. 8
	Advertised, Eng. News, Nov. 8 to 29.		
Dec. 17.	Wooden bridge,	Franklin, Neb.	Nov. 8

CONTRACT PRICES.

SHELL MARL.—De Land, Fla.—The council has contracted with the De Leon Springs Co. for 500 to 1,000 carloads of shell marl for paving the streets, at $13.50 per car, or 90 cts. per cu. yd. An equal amount of clay will be furnished free if it can be secured while getting out the shell.

SWING BRIDGES. Chicago, Ill.—The following bids were received Oct. 31 for constructing the superstructure and masonry for three highway swing bridges over the Chicago drainage canal. A brief description of these structures was given in our issue of Sept. 20, p. 223:

Superstructure.

Bidder.	Bridges, No. 1.	No. 2.	No. 3.
The Youngstown Bridge Co.	$21,974	$21,974	$21,974
	20,900	20,900	20,900
	11,900	11,900	11,900
Detroit Bridge & Iron Works.	16,392	16,392	16,392
Wisconsin Bridge & Iron Co.	13,992	13,893	13,893
Chicago Bridge & Iron Co.	14,201	14,201	14,201
Pittsburg Bridge Co.	20,670	20,670	20,670
Toledo Bridge Co., Toledo, O.	15,009	15,009	15,009
American Bridge Works,	19,115	19,115	19,115
C. L. Strobel, Chicago.	14,328	14,328	14,328
Milwaukee Bridge & Iron Wks	15,822	15,648	16,548
Shailer & Schniglau, Chicago.	20,490	20,490	20,490
Griffiths & McDermott Con. Co	17,099	17,099	17,099
	15,328	15,328	15,328

Masonry.

Bidder.	Price, per cu. yd. Abutments.	Pivot pier.
Lewis M. Loss, Chicago.	$9.35	$10.40
William Peace	5.50	5.50
Campbell & Dennis	9.87½	10.62½
McArthur Brothers Co.	9.40	10.20
E. D. Smith & Co.	5.50	6.50
Samuel W. Norton	7.60	8.95
Hill & O'Meara Const'n Co.	8.45	8.45
J. D. Morgan Mfg. & Const'n Co.	6.15	6.75
Anderson & Wenberg	9.95	9.75
Mason, Hoge & Co.	7.99	7.99
C. L. Strobel	7.80	7.80
F. S. Brown & Co.	7.25	7.25
Thomas Nicholson	6.98	9.25
Griffiths & McDermott Const'n Co	10.50	10.50

STONE WORK.—New Orleans, La.—The following bids were received by Maj. Jas. B. Quinn, U. S. Engineer Office, Oct. 25, for capping jetty with stone, Calcasieu River and Pass, La., the work requiring about 12,000 tons of granite capping blocks: Frank A. Hyatt, Beaumont, Tex., $5.40 per ton of 2,240 lbs.; Chas. Clarke & Co., Galveston, Tex., $4.50.

DREDGING.—Sabine Pass, Tex.—The following bids were received by Maj. Jas. B. Quinn, U. S. Engineer Office, New Orleans, Oct. 25, for dredging in the harbor of Sabine Pass: Julius Hess, Detroit, Mich., 16½ cts. per cu. yd.; New York Dredging Co., New York, 12 cts.; Thomas Doyle, Galveston, Tex., 12 cts.; Charles Clarke & Co., Galveston, Tex., 13 cts.; Rittenhouse Moore Dredging Co., Mobile, Ala., 9 cts.

STEEL DECK PLATES.—Washington, D. C.—The following bids were received at the army ordnance office, Oct. 29, for ten steel deck plates: Midvale Steel Co., 9½ cts. per lb.; Bethlehem Steel Co., 16 cts. per lb.; Carnegie Steel Co., $400 per gross ton.

SEWERS.—Hoboken, N. J.—The following bids were opened by the council Oct. 24 for the construction of a brick sewer in Jackson St., (1) oeing the price per lineal foot for 30 × 45-in. sewer, (2) price for each manhole and (3) the price bid for each receiving basin:

	1.	2.	3.
A. W. Rolker & Co.	$5.50	$19.00	$90.00
Joseph Waddington	7.50	40.00	150.00
M. T. Connolly	6.90	24.00	99.00
P. H. Flaherty, Jr.	5.10	20.00	115.00
John Hopkins	7.80	25.00	125.00
Thomas Cavanagh	5.65	25.00	125.00
P. T. Plunkett	6.00	12.00	70.00

METAL MARKET PRICES.

LEAD.—New York: 3.05 to 3.10 cts. Chicago: 2.95 cts. St. Louis: 2.92 to 2.95 cts.

NAILS.—Pittsburg: 95 cts. for wire, and 85 cts. to 90 cts. for cut at mill, in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.95 to $2; plain, $1.2 to $1.25 for carload lots at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $15. Pittsburg: $10.75 to $11.75. Chicago: $9.50 to $11.50.

TRACK MATERIAL.—New York: angle bars, 1.25 to 1.4 cts.; spikes, 1.55 to 1.7 cts.; track bolts, 2 to 2.1 cts. with square, and 2.15 to 2.3 cts. with hexagon nuts. Chicago: angle bars, 1.25 to 1.35 cts.; spikes, 1.65 to 1.75 cts.; track bolts, 2 to 2.1 cts., with hexagon nuts.

RAILS.—New York: $24 at eastern mills and at tidewater; old rails, $10.50 to $11.50 for iron and $8 to $8.50 for steel; steel rails, fit for relaying, $16 to $19; light rails, $22 to $24; girder rails, $24. Pittsburg: $24 for standard sections. Chicago: $25 to $27, old rails, $10.50 to $11 for iron and $7.25 to $10 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.25 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.25 to 1.35 cts.; steel plates, 1.25 to 1.4 cts. for tank, 1.4 to 1.5 cts. for shell, 1.6 to 1.65 cts. for flange, 1.75 to 2 cts. for ordinary firebox, 2 to 2.25 cts. for locomotive firebox. Pittsburg: beams, 1.25 to 1.35 cts.; channels, 1.25 to 1.35 cts., angles, 1.15 to 1.2 cts.; tees, 1.35 cts.; universal mill plates, 1.15 to 1.2 cts.; steel plates, 1.25 to 1.3 cts. for tank, 1.3 to 1.35 cts. for shell, 1.35 to 1.4 cts. for flange, 2.5 to 3.75 for ordinary firebox, and 3.35 to 3.5 cts. for locomotive firebox. Chicago: beams, 1.5 cts.; channels, 1.5 cts.; angles, 1.4 to 1.45 cts.; tees, 1.65 cts.; universal plates, 1.4 to 1.45 cts.; steel plates, 1.4 to 1.5 cts. for tank, 1.65 to 2.1 cts. for flange, 1.65 to 5 cts. for firebox.

INDUSTRIAL NOTES.

THE GENERAL ELECTRIC CO., will erect a new storehouse, 35 × 52 ft., and a laboratory at its works at Schenectady, N. Y.

BYRAM & CO., Detroit, Mich., have put in a 58-in. Colliau cupola furnace at the locomotive works of H. K. Porter & Co., of Pittsburg, Pa.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., will build a power station 150 × 102 ft., for the Nassau Electric Ry., of Brooklyn.

WESTINGHOUSE, CHURCH, KERR & CO. announce the removal of their office at Boston, Mass., from 620 Atlantic Ave. to the Exchange Building, 53 State St.

CARROL, PORTER & CO., of Pittsburg, Pa., are building two tanks 30 × 66 ft. and 6,000 ft. of 20-in. steel pipe for the St. Clair water-works on the south side.

THE NATIONAL FOUNDRY & PIPE WORKS, of Scottdale, Pa., will erect a new building 80 × 250 ft. and otherwise enlarge the plant on account of the increase of business.

THE SCHIFFLER BRIDGE CO., of Pittsburg, Pa., has a contract from the Chicago, Burlington & Quincy R. R. for the erection of a railway bridge, and a contract from the Scottdale Iron & Steel Co., Scottdale, Pa., for the erection of a foundry building.

THE NATIONAL SWITCH & SIGNAL CO., Easton, Pa., have recently received an order from the Boston, Revere Beach & Lynn R. R. for an interlocking plant of 18 levers to be installed at Orient Heights, Mass. This plant will also protect two street crossings.

THE BARR PUMPING ENGINE CO., of New York city, is delivering two vertical pumps of 5,000,000-gallons capacity to the city of Cincinnati, and has closed a contract at Abington, Mass., for a vertical, triple expansion pumping engine, with a duty guarantee of 120,000,000 ft.-lbs.; it was also the successful bidder for a duplex, compound condensing engine for the Charlestown water-works.

THE CONSOLIDATED CAR HEATING CO., Albany, N. Y., has awarded the contract for an addition to its factory, which will practically double its capacity. Its rapidly increasing business in electric heating appliances and the requirements of its compressed gas lighting business have necessitated increased facilities for manufacturing. The company has an order from the West End Ry., of Boston, Mass., for equipping 140 cars with its electric heater, the order being given after practical tests in competition with electric heaters offered by five other companies.

THE WESTINGHOUSE ELECTRIC & MFG. CO., of Pittsburg, Pa., has put in operation its new works at Brinton, Pa., 12 miles from Pittsburg, upon 40 acres of land, with a frontage of 2,300 ft. on the Pennsylvania R. R. The buildings include a machine shop 231 × 754 ft.; warehouse, 76 × 754 ft.; power house, 76 × 206 ft.; sheet iron department, 76 × 258 ft.; blacksmith shop, 83 × 243 ft. The area of the first floor of the machine shop is four acres, and of both floors, 7 acres. The area of the floors of the five buildings is 10.8 acres. There are also a foundry, carpenter shop and some minor buildings. Electric cranes traverse and connect the buildings. The new buildings were recently utilized for a reception and banquet given by the citizens of Pittsburg on the occasion of the annual encampment of the Grand Army of the Republic.

THE CATSKILL SHALE BRICK CO., of Catskill, N. Y., has been incorporated under the laws of West Virginia and will establish a plant for the manufacture of vitrified paving brick at Catskill. It is expected that the works will be completed and in operation by March, 1895. Contracts for the machinery have been let to J. W. Penfield, of Willoughby, O. The works will have a capacity of 100,000 brick per day. There will be 12 kilns, each having a capacity for 250,000 brick. The company, in addition to the Diamond Hill property, is now prospecting for other quarries, which it will purchase. A contract has been made with the Catskill Mountain Ry. for the transportation of the shale, the brick company to furnish its own cars. When the works are run at their full capacity, they will require 400 tons a day, or 40 carloads. Pres., Peter Callanan, of South Bethlehem, Pa.; Secy., John P. Harris, Jr., of Catskill, N. Y.

NEW COMPANIES.—Edgemont Stone Co., Omaha, Neb.; $500,000; stone quarrying and dressing; M. L. Parrotte, H. G. Candee and D. G. Duane.——Peerless Construction Co., Findlay, O.; streets and public improvements; $50,000; William V. Coons, Geo. H. Phelps and D. T. Davis.——Washington Waterway Subsidy Co., Seattle, Wash.; $1,000; waterway between Union and Washington lakes and the sea; Roger S. Green, G. H. Heilbron and E. O. Graves.——Central Sewer Pipe Co., Kansas City, Mo.; $20,000; W. S. Dickey and Johnson Martin.——Niagara Power, Land & Dockage Co., Buffalo, N. Y.; $250,000; E. M. Butz, Pittsburg, Pa.; Robert Snodgrass, Hamburg, N. Y.——Chicago City & Suburban Gas Co., Chicago, Ill.; $10,000,000; Arthur E. Sexton, Edward G. Mallon and I. W. Peffly.

MUNICIPAL BOND MARKET.

New York, Nov. 5, 1894.

What was said in these columns last week relative to the immediate future of the municipal bond market continues to be borne out by the facts in the situation. So uniform has the state of affairs become that what one bond expert has to say tallies rather exactly with all other criticisms. Charles Baldwin & Co., large dealers in New York, in this class of securities, note one feature, however, that has apparently escaped much notice. Speaking of the market in general, they say:

"At the present time there is a good demand for high grade bonds. Just now there are no very important sales, and nothing occurred last week to especially interest the purchasers of municipal bonds with the exception of the very high prices at which many issues sell, thereby signifying an increase of both confidence in and demand for this class of security. What alone has restricted the market has been the scarcity of new issues coming on the market, but on Tuesday, Nov. 6, 24 different municipalities and townships vote on propositions authorizing the issue of bonds aggregating $14,048,000, an amount which when issued will go far toward relieving the existing scarcity in the supply."

It would seem from this that the municipal and town authorities are awakening to the opportunities so frequently pointed out to them in these reviews, and are taking advantage of the chance to provide for needed public improvements on terms easier than obtainable at other times. The issuing of these $14,000,000 new bonds also means, of course, a boom in the engineering trade, as, with the exception of one or two small issues for refunding purposes, all of Tuesday's issues are for the purpose of securing new water-works, roadways, sewers and other improvements in which the engineering trades are interested.

It is still possible to furnish significant instances of the trend of the municipal bond market. At the sale of $71,000 Medford, Mass., 4 per cent. coupon public building bonds, there were 15 bidders; two houses, Brewster, Cobb & Estabrook and E. H. Gay & Co., both of Boston, made the highest bid, 104.78, and the loan was divided between them. There were 12 bids at better than 104, and only three at less than 104, the lowest being 103.4. At the sale of $25,000 Taunton, Mass., 4 per cent. 10 and 20-year bonds, there were 19 bidders, E. H. Rollins & Sons carrying off the prize, after paying the big figure of 106.019 for the lot. These high prices and the large number of bidders, even when the amount in question is comparatively trivial, serve well in indicate how eager bond dealers are to pick up new supplies. A large Stock Exchange house says that it sold more bonds in October than in any other month this year, and that its stock has run down to the lowest ebb without any likelihood of early renewal.

Bond dealers are much interested in a Supreme Court decision just handed down in favor of the holders of the bonds of the village of Howell, Mich. These bonds were marked "Improvement Bonds," but, as was afterwards discovered, were secretly negotiated as an aid to the Toledo, Ann Arbor & North Michigan Railway Co., now in process of evolution from bankruptcy. The Michigan courts declared the issue void on the ground that they were railway bonds and that the security nominally in back of them was not liable. The United States Supreme Court holds that the innocent purchaser was not bound to go back of the face of the bond, and that the town is liable. The bonds were sold by the railway company to Spitzer & Co., and by the latter to Griswold & Gillett, of New York, who afterwards sold them to banks in New York, Pennsylvania and Connecticut.

Blair Bros. & Co. have already disposed of $500,000 worth of the $1,300,000 Boston 4 per cent. bonds recently purchased by them. They offer the bonds due in 1924 at 115 and interest, paying the purchaser 3.21 per cent., and the bonds due in 1914 at 111¾ and interest, a price which nets the purchaser on the average 3.20 per cent. These prices are not extraordinarily high compared with other quotations now ruling.

MUNICIPAL BONDS.

	Price.
City of Rochester, N. Y., Water 7s	127
City of St. Louis, Mo., Refunding, 6s	121½
City of Milwaukee, Wis., 5s	118½
State of California, Dock 4s	110
City of Menominee, Mich., School 6s	113
City of Birmingham, Ala., Impvt. 6s	108
City of Lawrence, Mass., Funding 4s	108½
Asbury Park, N. J., Water 5s	108
City of Mt. Vernon, N. Y., Ass. 5s	108
" " " " " School 4s	105⅜
New Utrecht, N. Y. (Brooklyn), Impvt. 5s	113⅝
State of Idaho, Wagon Road 5s	108½
City of Manchester, N. H., 4s	106¼
City of Lawrence, Mass., 4s	108½
City of Omaha, Neb., 5s	111
City of Boston Park Loan Reg. 5s, 1914	111¾
City of Boston Park Loan Reg. 4s, 1924	115

RAILWAY STOCK MARKET.

New York, Nov. 5, 1894.

The situation in the railway stock market is a mixed one. There is no possibility of accurately gaging it by the developments in the Stock Exchange, inasmuch as that remains too narrow, too restricted, too purely professional to offer the slightest indication as to the genuine state of affairs. The ups and downs recorded in the last few days indicate solely pure, speculative sentiment, such illogical movements being made as an advance in Reading when a statement of earnings is issued showing large deficits after fixed charges are calculated. Covering by traders short of the market—a foregone conclusion in so narrow a market—led to rallies at odd moments during the past week, but that is no revelation of the railway stock market, speaking broadly.

The situation is mixed. On the one hand are the reassuring features evidenced by the gradual improvement in commercial lines, and the increasing growth of confidence in all business directions. On the other hand, people generally are indisposed to take one slightest risk in stocks, thus betraying a failure as yet to put full reliance on any favorable developments in the situation. As one banker epitomizes it: "The general and material prosperity of the country is the only safe and sure condition on which to predicate any sustained advances in the market;" that "safe and sure condition is apparently again at hand, but are people generally constrained to appreciate it?"

It might be well in this connection to quote some earnings of representative railways as indicative of the state of affairs in various sections of the country. The recent decline in the "Coalers," based, as it was, on reports of bad business in the coal trade, was apparently well founded when one consults the report issued by the Reading Company for September and the 10 months ending there. (In the figures quoted the accounts of the Reading Coal & Iron Co. are included.) Both companies for September show a net loss of $326519 and a deficit, after charges, of $236,082 against a surplus in 1893 of $95,562. For the 10 months there is a decrease in net earnings of $765,241, and a failure to earn fixed charges by $2,584,467. This is harly encouraging to the believers in the road's possibility to make money. More flattering to its stockholders is the report of the Louisville & Nashville, whose September net earnings were $686,737, a gain of $24,245, while for the three months ended Sept. 30, it reports a net gain of $139,658. The New York Central, however, did not do as well for the quarter, as there is a loss in net earnings of $217,695, which results in a deficit after paying charges and dividends of $96,942, as compared with a surplus in 1893 of $196,056. St. Paul, a Granger road, makes equally as poor a showing. Net earnings for September were $1,005,609, a decrease of $161,559; estimates based on this show an apparent deficit for the three months of the fiscal year after paying the preferred dividend alone of over $150,000. These reports are hardly a matter of much gratification to security holders, and evidence more than anything else the reasons for the general loss in confidence.

RAILWAY STOCK MARKET.

Railway stocks.	Closing prices Nov. 3.
Alton & Terre Haute	30½
Atchison, Topeka & Santa Fe	5⅝
Baltimore & Ohio	67½
Canada Southern	50
Chesapeake & Ohio	17¼
Chicago, Burlington & Quincy	73
Chicago & Northwestern	101⅜
Chicago, Milwaukee & St. Paul	61
Chicago, Rock Island & Pacific	59⅞
Cleveland, Cincinnati, Chicago & St. Louis	38
Delaware, Lackawanna & Western	159
Delaware & Hudson	124½
Hocking Valley	18
Illinois Central	90
Lake Shore & Michigan Southern	132
Louisville & Nashville	54¼
Missouri Pacific	28
Missouri, Kansas & Texas	13⅛
Mobile & Ohio	18½
New Jersey Central	98½
New York Central	98½
New York & New England, all a. p.	31⅝
New York, New Haven & Hartford	190
New York, Chicago & St. Louis, 1st pfd	65¼
New York, Lake Erie & Western	13
New York, Ontario & Western	15¾
New York, Susquehanna & Western	14¾
Northern Pacific	4⅛
Northern Pacific, pfd	16⅞
Philadelphia & Reading	18
Richmond Terminal	17⅝
St. Paul & Omaha	34¾
Southern Pacific	18½
Texas Pacific	9¾
Union Pacific	11⅞
Wabash, pfd	14
Wheeling & Lake Erie	11

BOSTON RAILWAY STOCKS.

	Nov. 3.
Boston & Albany	204½
Boston & Maine	149
Fitchburg, pfd	77
Old Colony	177

PHILADELPHIA RAILWAY STOCKS.

	Nov. 3.
Lehigh Valley	35½
Pennsylvania Railroad	51